

**SCHOOL OF
CIVIL ENGINEERING**

INDIANA

DEPARTMENT OF TRANSPORTATION

JOINT HIGHWAY RESEARCH PROJECT

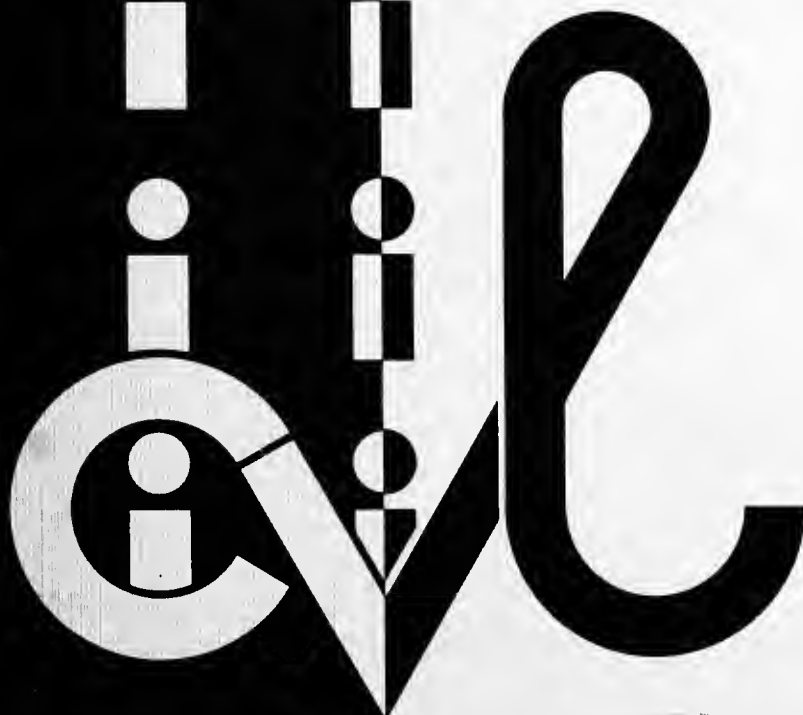
FHWA/IN/JHRP-92/8

Final Report

**ENGINEERING SOILS MAP OF
RANDOLPH COUNTY, INDIANA**

Wei-Yao Chen

Arvind Chaturvedi



PURDUE UNIVERSITY



JOINT HIGHWAY RESEARCH PROJECT

FHWA/IN/JHRP-92/8

Final Report

**ENGINEERING SOILS MAP OF
RANDOLPH COUNTY, INDIANA**

Wei-Yao Chen

Arvind Chaturvedi

Digitized by the Internet Archive
in 2011 with funding from
LYRASIS members and Sloan Foundation; Indiana Department of Transportation

FINAL REPORT
ENGINEERING SOILS MAPS OF RANDOLPH COUNTY, INDIANA

by
Wei-Yao Chen
Arvind Chaturvedi

Joint Highway Research Project

Project No.: C-36-51

File No. 1-5-2-89

Prepared as Part of an Investigation

Conducted by
Joint Highway Research Project
Engineering Experiment Station
Purdue University

in cooperation with

Indiana Department of Transportation
Indianapolis, Indiana

School of Civil Engineering
Purdue University
West Lafayette, Indiana

March 16, 1992

ACKNOWLEDGMENTS

The author wishes to express his appreciation to Professor C. W. Lovell for providing the opportunity to work on this project.

Thanks are also due the members of the Joint Highway Research Board for their continued support of the county soil mapping project.

The author also wishes to acknowledge D. Yang for skillfully drafting the Engineering Soil Map of Randolph County and other figures included in this report, Rita Pritchett and Mary Hardway for typing the classification test results presented in Appendix A, and Will McDermott for formatting the text and final preparation of this report.

TABLE OF CONTENTS

	Page
ACKNOWLEDGMENTS	i
LIST OF TABLES	iv
LIST OF FIGURES	v
LIST OF APPENDICES	vi
INTRODUCTION	1
DESCRIPTION OF THE AREA	3
GENERAL	3
CLIMATE	6
DRAINAGE FEATURES	6
WATER SUPPLY	10
PHYSIOGRAPHY	15
TOPOGRAPHY	17
GEOLOGY OF RANDOLPH COUNTY	19
STRUCTURAL GEOLOGY	19
GLACIAL GEOLOGY	19
BEDROCK GEOLOGY	24
PLEISTOCENE GEOLOGY	27
LANDFORM-PARENT MATERIAL REGIONS	32
GLACIAL DRIFT	32
Ground Moraine	32
Ridge Moraine	34
Engineering Considerations in Glacial Drift	35
GLACIAL-FLUVIAL DRIFT	35
Outwash Plain	36
Engineering Considerations in Glacial-Fluvial Drift	36
FLUVIAL DRIFT	36
Flood Plain	36
Terrace	37
Engineering Considerations in Fluvial Drift	37

LACUSTRINE DRIFT	37
Lacustrine Plain	38
Engineering Considerations in Lacustrine Drift	38
CUMULOSE DRIFT	38
Muck Basin	38
Engineering Considerations in Cumulose Drift	39
MISCELLANEOUS	39
Gravel Pits	39
Marsh and Swamps	40
SUMMARY OF ENGINEERING CONSIDERATIONS IN RANDOLPH COUNTY .	40
REFERENCES	42
APPENDICES	46

LIST OF TABLES

	Page
1. Population Summary of Randolph County	5
2. Climatological Summary for Randolph County	7
3. Twenty Eight Year Normal Climate Data	8
4. 1989 Water Use Summary for Randolph County	14
5. Summary of Engineering Considerations for Landform-Parent Material Regions in Randolph County	41

LIST OF FIGURES

	Page
1. Location Map of Randolph County	4
2. Drainage Map of Randolph County	9
3. Major Watersheds of Indiana	11
4. Groundwater Sections of Indiana	12
5. Map Showing Availability of Ground Water in Randolph County	13
6. Physiographic Units and Glacial Boundaries in Indiana	16
7. Topographic Map of Randolph County	18
8. Bedrock Geology of Randolph County	20
9. Thickness of Drift of Randolph County	21
10. Bedrock Topography of Randolph County	22
11. Thickness of Unconsolidated Deposits of Randolph County	23
12. Bedrock Geology of Indiana	25
13. Generalized Geologic Column of Randolph County	26
14. Unconsolidated Deposits of Randolph County	28
15. Schematic Section Showing Relationships of Unconsolidated Deposits	30

LIST OF APPENDICES

	Page
A. Classification Test Results for Selected Engineering Projects in Randolph County	46
B. Physical and Chemical Properties of Agricultural Soils in Randolph County	119
C. Engineering Index Properties of Agricultural Soils in Randolph County	123
D. Statistical Stream Flow Data for Selected Streams in Randolph County	128

ENGINEERING SOILS MAP
OF
RANDOLPH COUNTY, INDIANA

INTRODUCTION

The engineering soils map of Randolph County, Indiana that accompanies this report was prepared by airphoto interpretation techniques using accepted principles of observation and inference. The 7-inch x 9-inch aerial photographs used in this study, having an approximate scale of 1:20,000, were taken in the summer of 1941 for the United States Department of Agriculture and were bought from that agency. The attached Engineering Soil Map was prepared at a scale ratio of 1:63,360 (1 inch = 1 mile).

Standard symbols, which were developed by the staff of the Airphoto Interpretation Laboratory of the School of Civil Engineering at Purdue University, were employed to delineate landform-parent material associations and soil textures. The text of this report represents an effort to overcome the limitations imposed by adherence to a standard symbolism and map presentation.

Extensive use was made of the Agricultural Soil Survey of Randolph County published in 1987 (1). It was particularly useful as a cross-reference to check soil boundaries, and to locate gravel pits and ponds that were not present on the 1941 aerial photographs.

The map and report are part of a continuing effort to complete a comprehensive soil survey for the state of Indiana. Included on the map is a set of subsurface soil profiles that illustrate the approximate variation that is anticipated in each landform-parent material area.

The profiles were constructed from information obtained from agricultural literature and from boring data collected from roadway and bridge site investigations (31-48). Boring locations are shown on the map. Appendix A contains a summary of classification test results for these locations.

The text of this report supplements the Engineering Soil Map. It includes general descriptions of the study area, and the different landform-parent material regions. Engineering considerations associated with each region are also briefly addressed.

The predominant soils associated with each landform-parent material classification are covered in the discussion of the different landforms in the county. The physical, chemical, and engineering index properties of these soils are included in Appendices B and C.

Numbers in parentheses refer to items in the list of references.

DESCRIPTION OF THE AREA

GENERAL

Randolph County is located centrally along the eastern border of the State of Indiana as illustrated in Figure 1. The county was established in 1818 and named after Thomas Randolph, a close friend of Thomas Jefferson and Governor of the Virginia State born in the county (1). The county is bordered by the State of Ohio on the east, by Wayne County on the south, by Henry and Delaware Counties on the west, and by Jay County on the north. The county government is located at Winchester, which is about eighty miles northeast of Indianapolis. The State's second largest monument of the Civil War is erected here in 1888 (1). The county is about 22 miles wide (east-west) by 20 miles long (north-south), and consists of an area of 290,253 acres, or 453.5 square miles (2).

Randolph County is served by three railroads, which pass through or near all the major towns in the county. The county also has good highway transportation facilities. The U.S. Highway 27 and Indiana Highways 1 and 227 are the major roads in north-south direction, whereas Indiana Highways 32 and 28 and U.S. Highway 36 are in east-west direction. All public roads in the county are either paved or surfaced with gravel (2).

The population of Randolph County was about 30,000 in 1978, and is expected to be more than 40,000 by the year 2000. The population density was 70 people per square mile. Winchester, the county seat, has a population of about 6,000. A population summary of the important cities and towns in the county is given in Table 1.

Manufacturing is the leading enterprise. Approximately three-fourth of the work force of the county is engaged in this business. Approximately 81 % of the acreage in the county is highly productive farmland. Corn, soybean, wheat, and tomatoes are the major agricultural products. From 1967 to 1978, the acreage used under urban development increased by 5 %.

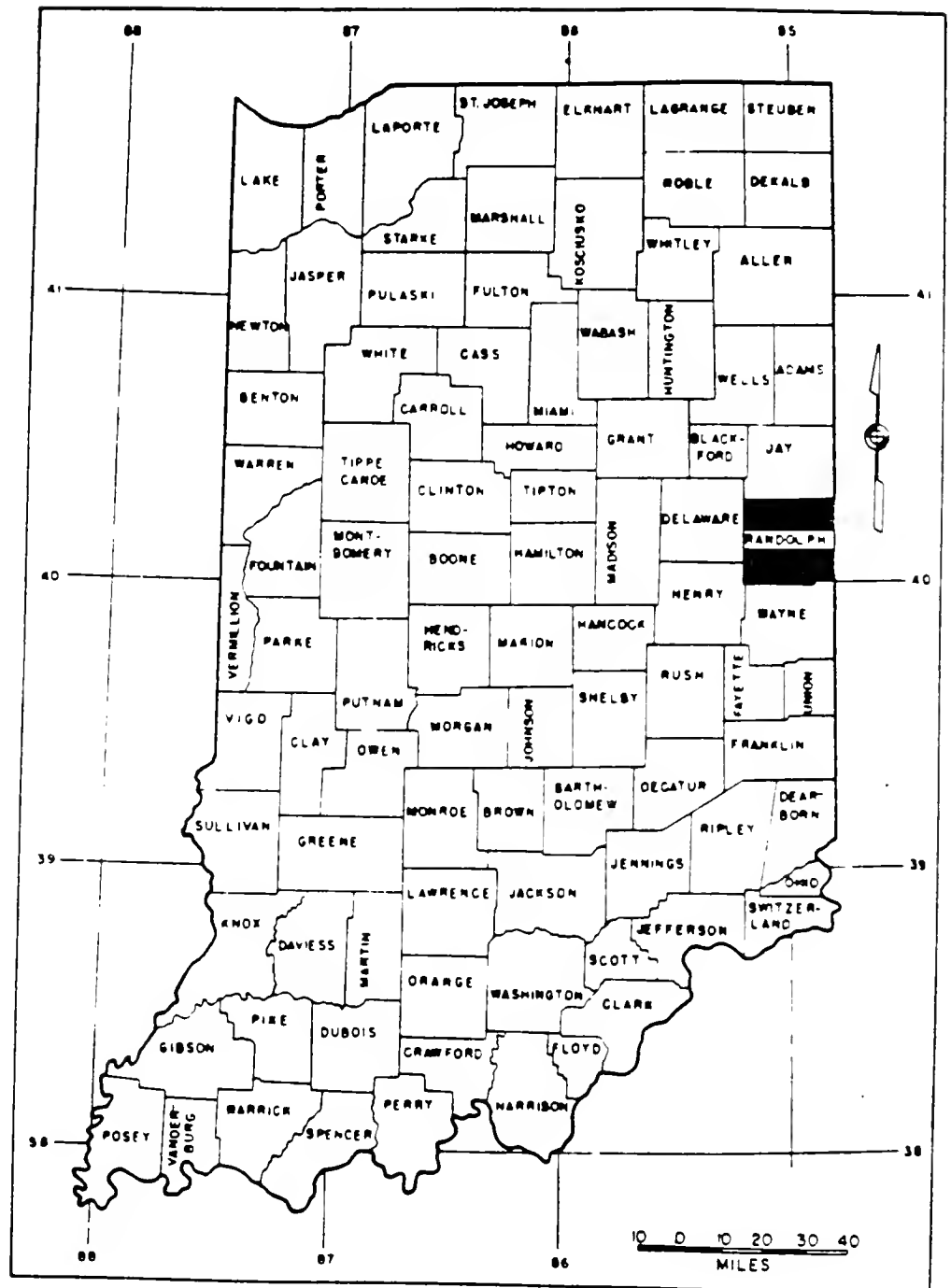


FIGURE 1. LOCATION MAP OF RANDOLPH COUNTY

Table 1. Population Summary of Randolph County (3)

	Population		Population Change (1970-1980)	
	1980 Census	1970 Census	Difference	% Change
City-Town				
Albany	2625	2293	332	14.48
Farmland	1560	1262	298	23.61
Losantville	306	212	94	44.34
Lynn	1250	1360	-110	-8.09
Modoc	243	275	-32	-11.64
Parker	1414	1179	235	19.93
Ridgeville	933	924	9	0.97
Saratoga	338	406	-68	-16.75
Union City	3908	3995	-87	-2.18
Winchester	5659	5493	166	3.02
Urban Areas	15611	15106	505	3.34
Rural Areas	14386	13809	577	4.18
County Total	29997	28915	1082	3.74

On the other hand, about 85 % of the total acreage of the county is expected to be agricultural land by the year 2010.

CLIMATE

Table 2 and 3 give data on temperature and precipitation for this area as recorded at Farmland and Winchester, Indiana. In summer the average temperature is 71 degrees F, whereas in winter is 27 degrees. The highest and lowest temperature recorded in Randolph County are 102 degrees in 1953 and -20 degrees in 1972, respectively. The annual precipitation is about 37 inches (2), and 57 percent of this usually falls in April through September. Thunderstorms occur on about 45 days each year (2).

Average seasonal snowfall is about 22 inches. On the average, 14 days of the year have at least 1 inch of snow on the ground. The prevailing wind is from the south-southwest with the highest average wind speed, 12 miles per hour, occurring in the spring.

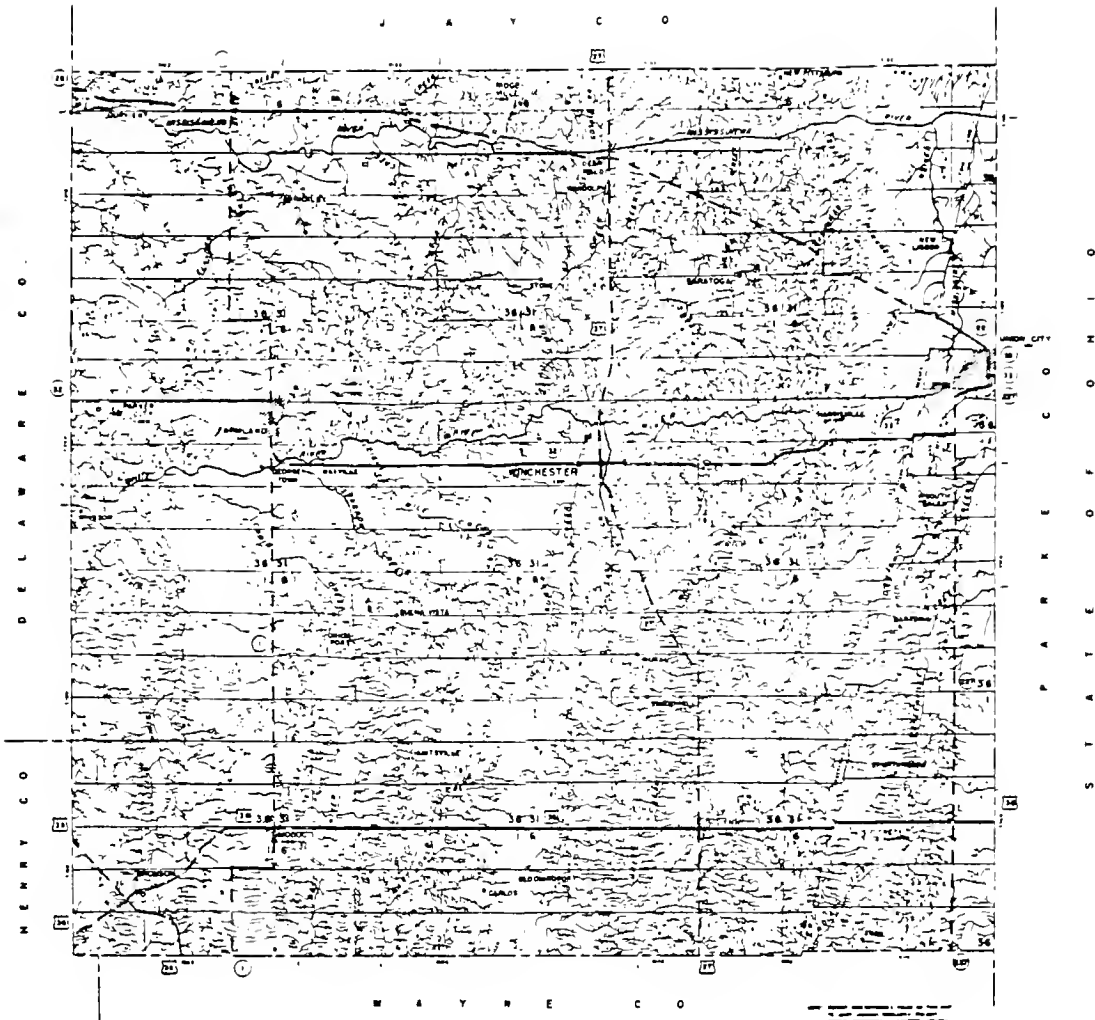
DRAINAGE FEATURES

Randolph County forms the headwaters for 3 major river systems because of its highest average altitude in the State of Indiana. The drainage features of Randolph County are shown in Figure 2.

The county is drained by 3 major river systems. The northern portion of the county is drained by the Mississinewa River, which flows westward across the county and drains about one-third of the county area. The central and southern portions of the county are drained by the West Fork of White River and its tributaries such as Nettle Creek, Martindale Creek, Greens Fork, Nolands Fork, and Whitewater River. The gradient of the main stem of the stream is about 6 feet to the mile, whereas the gradients of the tributaries usually average over

Table 3. Twenty Eight Year Normal Climate Data (2)
(Recorded in the period 1951-78 at Winchester, Indiana)

For The Period 1951-78				
	Temperature (F)			Average Precipitation
MONTH	Average daily maximum	Average daily Minimum	Average	(inches)
January	33.1	15.9	24.5	2.36
February	36.3	18.5	27.4	1.98
March	46.3	27.3	36.9	3.24
April	60.0	38.7	49.4	4.07
May	70.7	49.0	59.9	3.82
June	80.1	58.5	69.3	4.09
July	83.6	61.8	72.7	3.59
August	82.2	59.3	70.8	3.10
September	76.4	52.4	64.4	2.79
October	64.8	41.4	53.2	2.54
November	49.5	31.4	40.5	2.84
December	37.3	21.6	29.5	2.80
Annual	60.0	39.7	49.9	----



DRAINAGE MAP
RANDOLPH COUNTY
INDIANA

PREPARED FROM
1941 AERIAL PHOTOGRAPHS
BY
JOINT HIGHWAY RESEARCH PROJECT
AT
PURDUE UNIVERSITY
1952



FIGURE 2. DRAINAGE MAP OF RANDOLPHN COUNTY (5)

10 feet per mile. Finally, the rest of the county (southeast edge) drains into the Stillwater (Ohio) River basin (6).

WATER SUPPLY

Randolph County forms the headwaters for several water basins. The northern, central, and southern parts belong to the Wabash River watershed, White River watershed, and Whitewater River watershed, respectively (Figure 3). No natural lake occurs in the county, and artificial ponds are scarce (6). Nevertheless, water for livestock is available from streams in many localities.

The major water resource in Randolph County is ground water. Both public and private water supplies are obtained from drilled wells. Randolph County is situated in two ground water sections. They are the Northern Till Plain Section and the Southern Till Plain Section (Figure 4). Usually, water for farm uses is within 40 feet of the surface, but ample supplies for households, livestock, irrigation, and industry can be obtained at a greater depth (2).

The depth and amount of water available depends on the underlying geological formations. Therefore, wide variation in ground water availability is expected. In general, the yield of ground water in the county is stable, and not greatly affected by precipitation or drought. The two major aquifers in the Randolph County are the sand and gravel deposits within the glacial drift, and the limestone of Silurian age (Figure 5). The deposit of subsurface sand and gravel, ranging from 30 to over 100 feet deep, provides water supplies in nearly all the county. In a few localities where glacial drift is too thin, reliable supplies can be obtained from limestone bedrock. This limestone aquifer is also available throughout the county except for those places where the limestone has been completely eroded or removed. The water use summary for Randolph County is shown in Table 4.

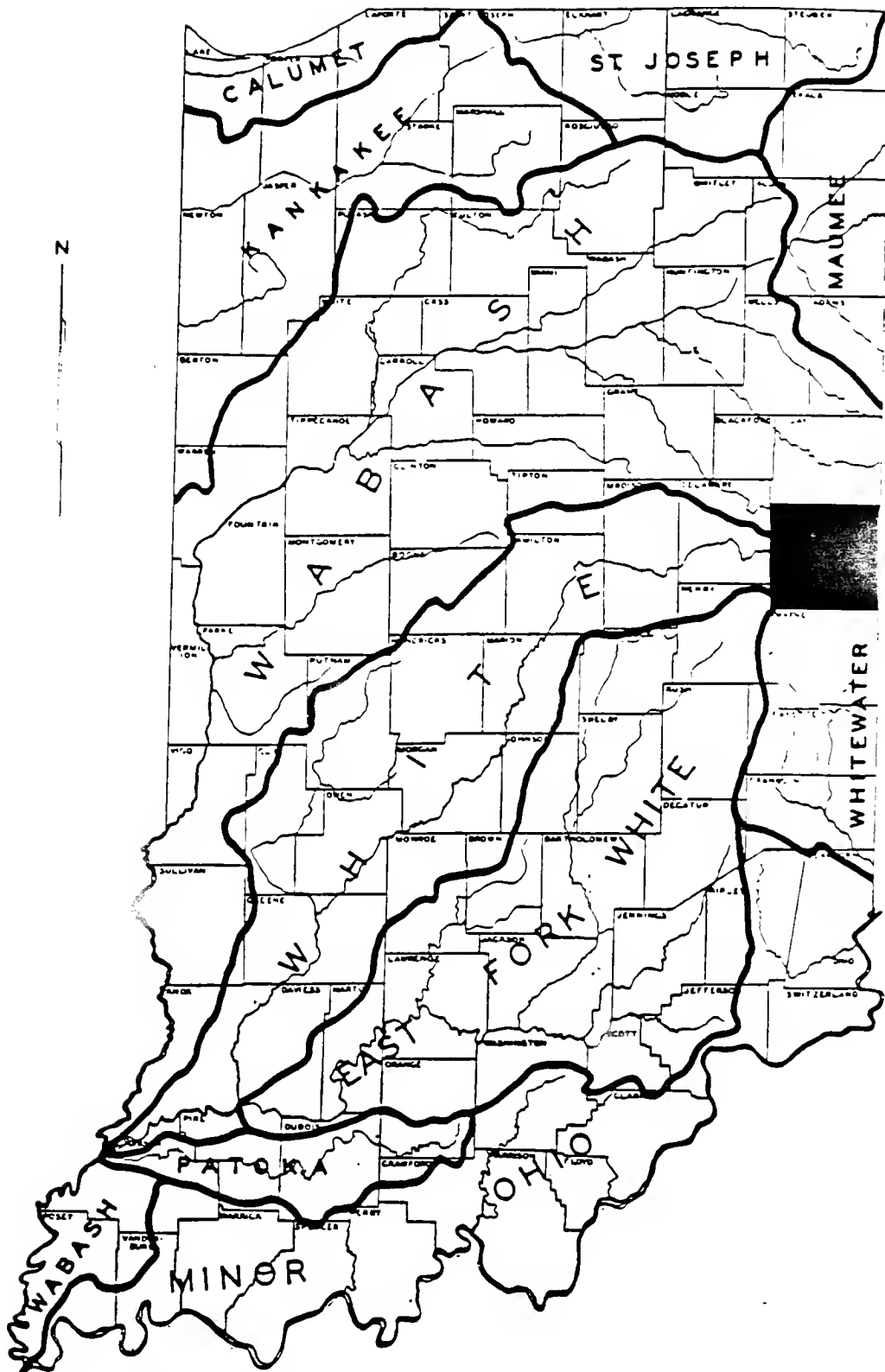


FIGURE 3. MAJOR WATERSHEDS OF INDIANA (7)

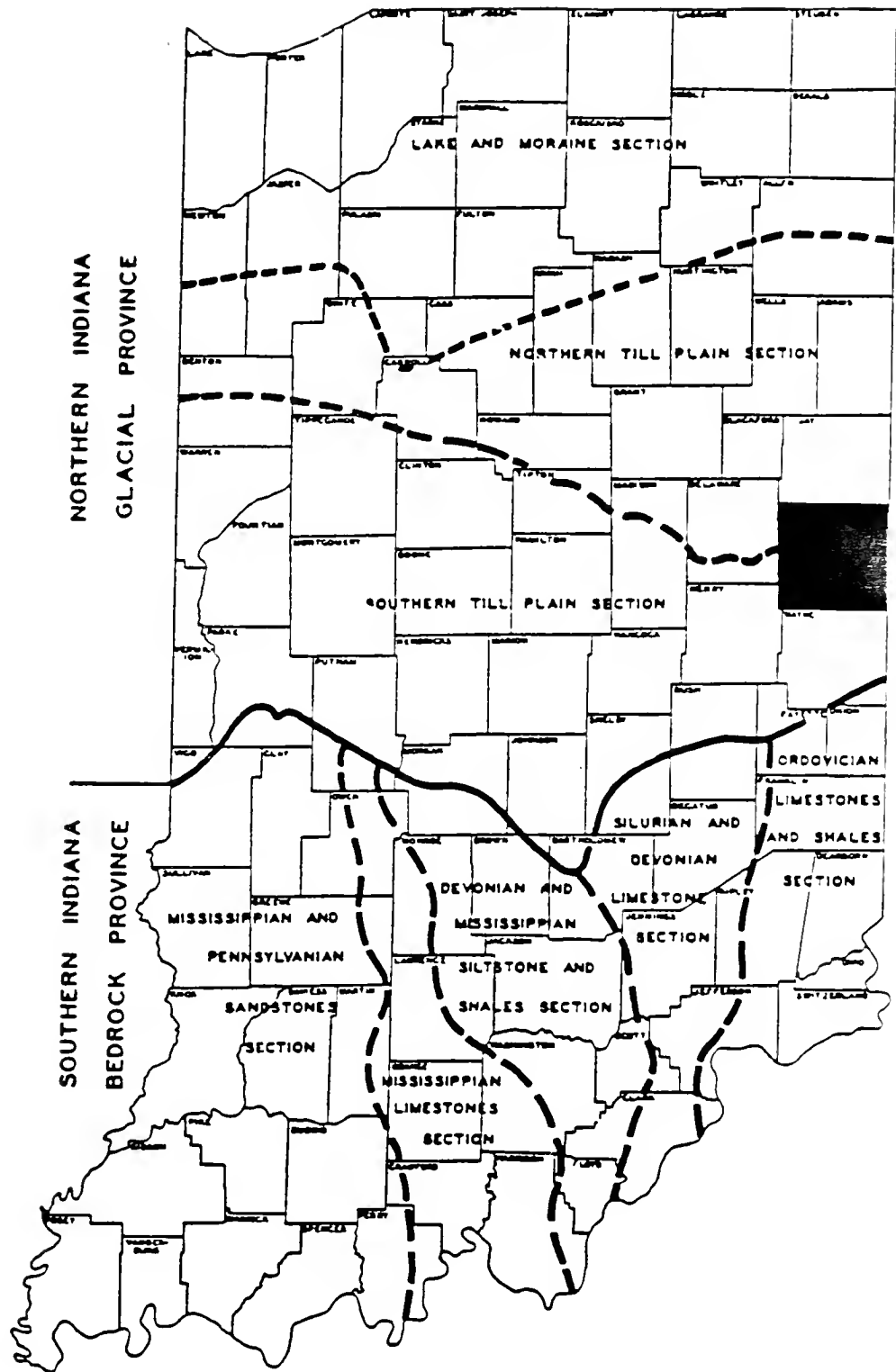
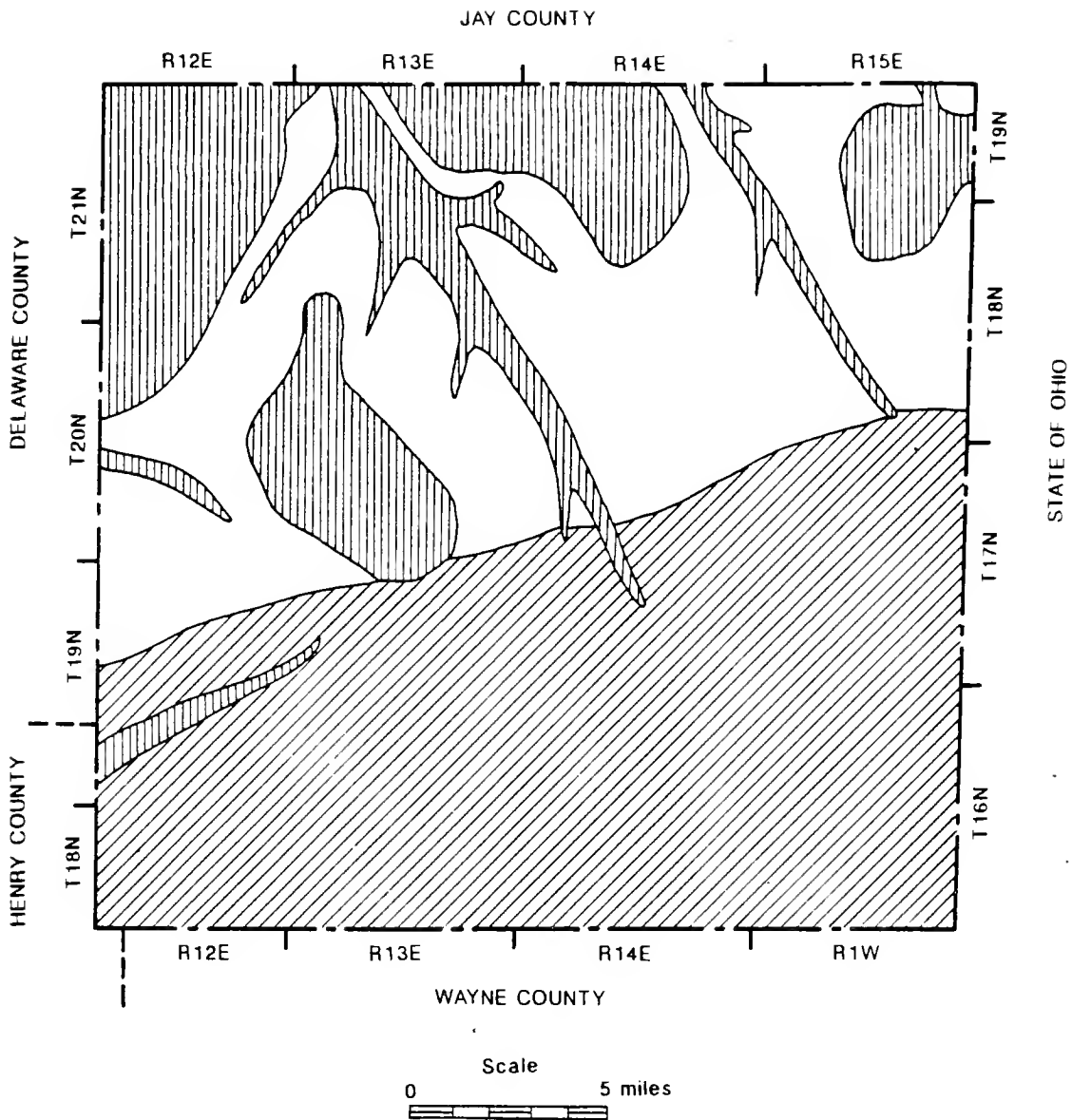


FIGURE 4. GROUNDWATER SECTIONS OF INDIANA (7)



EXPLANATION




-  Area in which yields up to 250 gallons per minute can be developed
-  Areas in which yields of over 250 gallons per minute can be developed from sand and gravel deposits
-  Area in which yields of over 250 gallons per minute can be developed from sand and gravel deposits or from the underlying limestone

FIGURE 5. MAP SHOWING AVAILABILITY OF GROUND WATER
IN RANDOLPH COUNTY (6)

Table 4. Water Use Summary for Randolph County (8)
(1989 usage in millions of gallons)

MONTH	SOURCE		
	Ground	Surface	Total
January	69.02	31.49	100.51
February	65.58	36.53	102.11
March	70.25	31.35	101.59
April	72.20	38.08	110.28
May	79.21	37.28	116.49
June	81.65	38.69	120.34
July	73.63	37.84	111.47
August	90.04	38.70	128.74
September	81.63	38.46	120.09
October	85.56	40.00	125.56
November	78.77	41.24	120.01
December	78.73	30.56	109.29
Total	926.24	440.24	1366.48

PHYSIOGRAPHY

The State of Indiana can be divided into two areas. The northern portion, covered by glacial drift, belongs to the great Central Lowland province, whereas the unglaciated southern section belongs to the Low Plateau province. The central Lowland province in Indiana can be further subdivided into two portions. The northern section, Northern Moraine and Lake Region, is characterized by lakes and lake-bed deposits, whereas the southern portion, Tipton Till Plain, consists of level or undulating deposits of drift without lakes or appreciable stream dissection (9). Randolph County is located entirely within the Tipton Till Plain (Figure 6).

The Tipton Till Plain, extending across the central portion of the state from east to west, has more or less uniform topography compared with rugged and weathered southern Indiana. Since the region is monotonously flat, those rivers present are on low gradient. Only an occasional break in topography can be seen resulting from small moraines (9).

The county has seven physiographic subdivisions – the Knightstown end moraine, the Mississinewa end moraine, the Union City end moraine, outwash plains, till plains, bottom land, and lake plain.

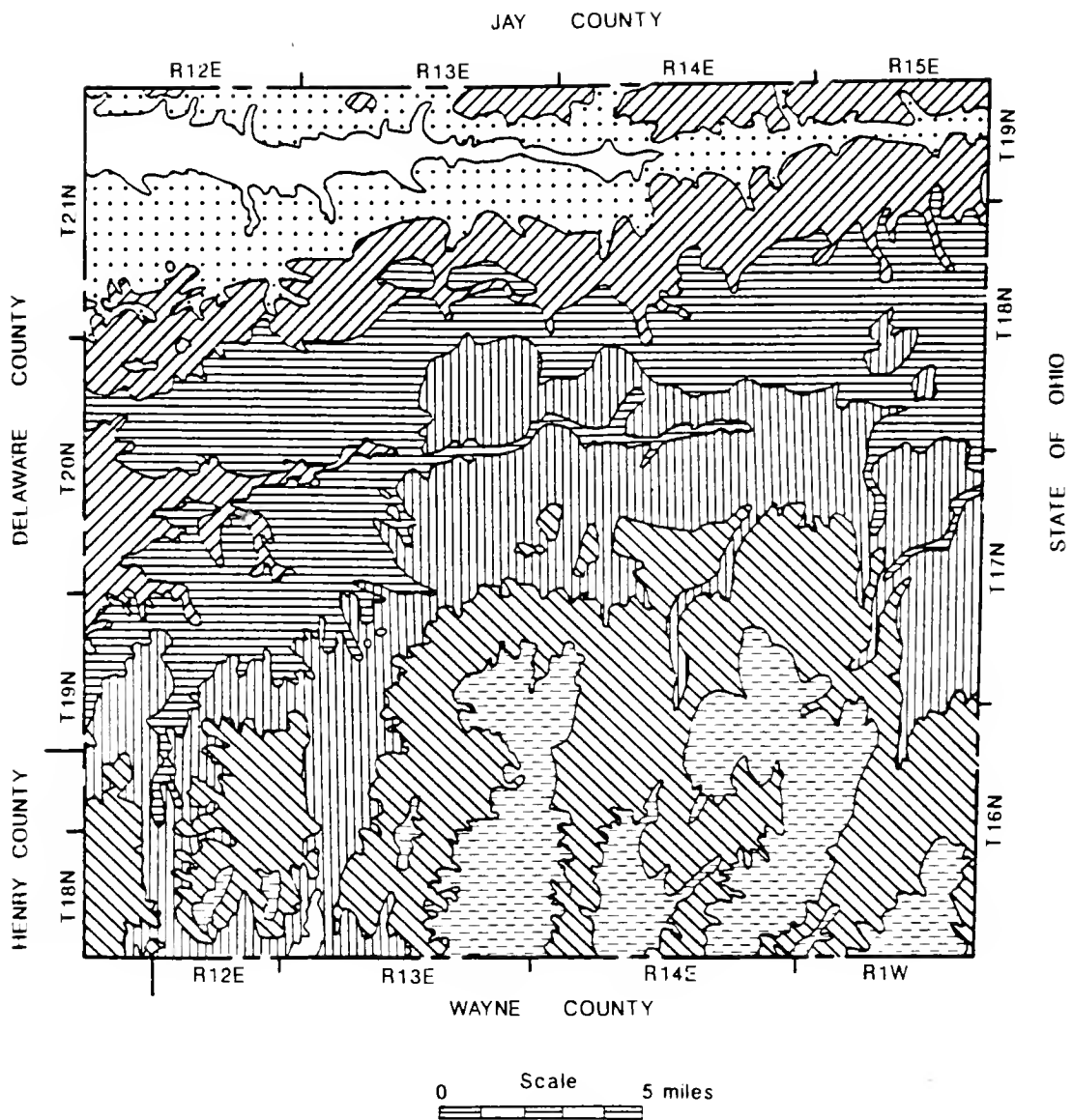
The Knightstown end moraine is incised by numerous streams and drainage ways. In general, large boulders are found on the surface and in the subsoil (2). The Mississinewa and Union City end moraines have many locally abrupt changes in slope, surface texture, and land use. Many irregular shaped areas of muck are in deep depressions and potholes. The outwash plains are often seen along the Mississinewa and White Rivers and other streams with that of the Mississinewa River being the largest one. It is 0.5 mile to 1.5 miles wide in most places. The till plains are almost flat in most areas. However, areas along the major river valleys are gently sloping to moderately steep. The remaining portions are bottom land and lake plains.

The bottom land is characterized by nearly level soils along the streams and creeks, while the lake plains have many irregular shaped areas of muck in deep depressions and potholes (2).

TOPOGRAPHY

The county has been mapped by the U.S. Geological Survey. There are 12 quadrangle maps in the U.S. Geological Survey $7\frac{1}{2}$ -minute series that provide topographic coverage for the Randolph County. They are Carlos, Modoc, Maxville, Farmland, Ridgeville, Redkey, Spartanburg, Lynee, Union City, Winchester, Cosmos, Deerfield quadrangles.

The general topography of Randolph County is shown in Figure 7. The land surface ranges from flat and undulating to broadly rolling. There is little abruptness and very few deeply incised streams. The average altitude of the county is the highest in the State of Indiana. The highest altitude reaches 1257 feet above sea level, which is an area of Greensfork Township about 3 miles northeast of Lynn. The lowest point is 930 feet above sea level. It is an area of Green Township near the Mississinewa River. The greatest local relief is 140 feet.



EXPLANATION

Elevation Range in Feet

Contour Interval = 50 Feet








 900 - 950	 1050 - 1100	 1200 - 1250
 950 - 1000	 1100 - 1150	
 1000 - 1050	 1150 - 1200	

FIGURE 7. TOPOGRAPHIC MAP OF RANDOLPH COUNTY (11)

GEOLOGY OF RANDOLPH COUNTY

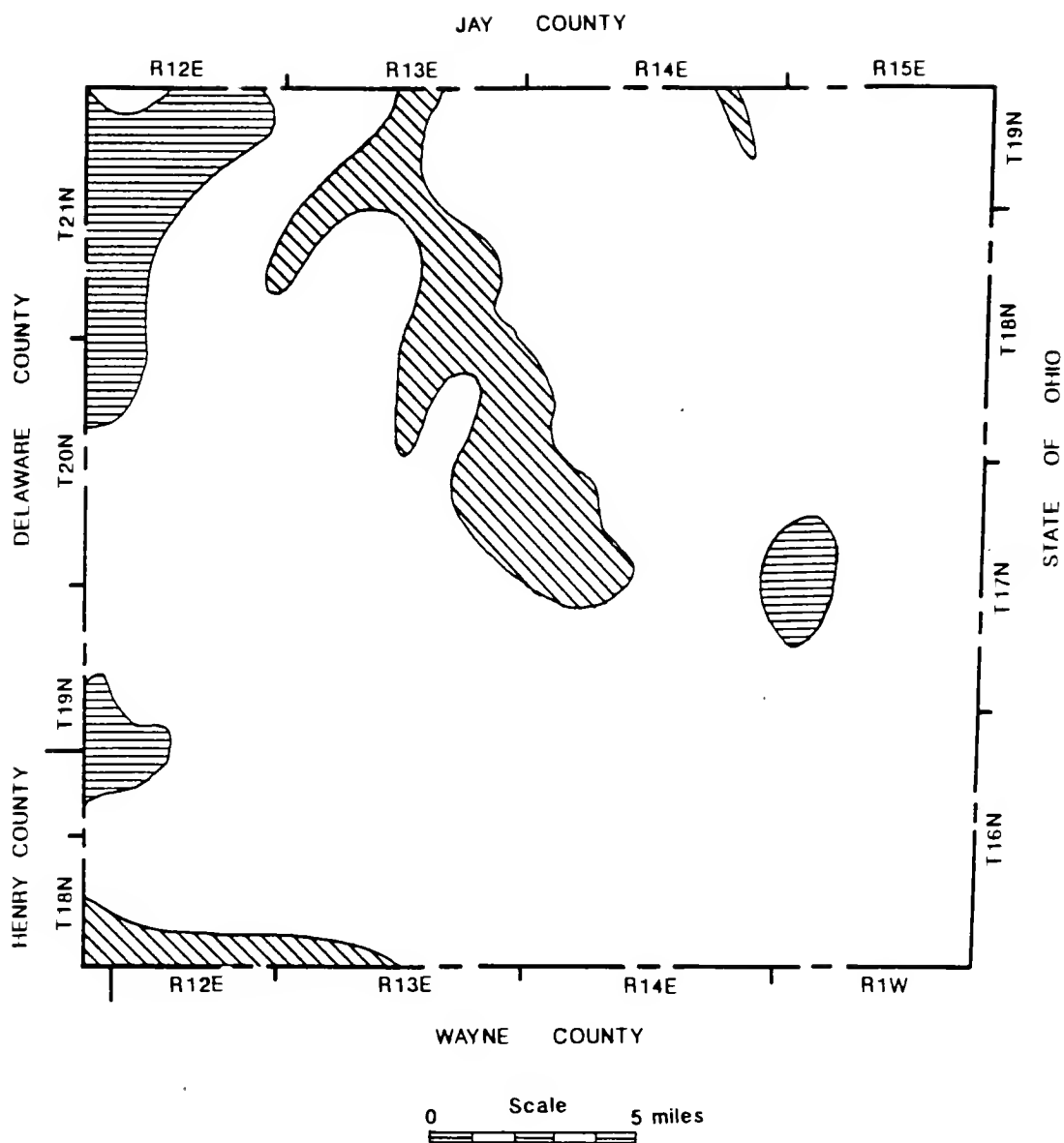
Randolph County is covered by glacial deposits left by the continental ice sheets that spread outward from Canada. The bedrock is composed primary of dolomite and limestone, Ordovician to Silurian in age (Figure 8).

STRUCTURAL GEOLOGY

Randolph County lies on the crestal area of the Cincinnati Arch, which is broad and platformlike. This broad crestal feature, tending northwestward to Lake County from east-central Indiana, has breadths of a few scores of miles (13). The regional dip is low or indeterminate, whereas it is 35 feet or more per mile on the flanks of the arch (13). The Cincinnati Arch along with two adjacent large structural depressions, the Michigan Basin to the north and the Illinois Basin to the southwest, have a major influence on the outcrop pattern of Silurian formations (13-15).

GLACIAL GEOLOGY

The advance of ice covered Randolph County in the glacial age, and left a series of moraines behind as it retreated. The rock minerals contained in the glaciers reflects the bedrock to the northeast into Canada (6,16). The present day thickness of these deposits ranges from a few feet to over 300 feet in the county (Figure 9). However, the current surface topography does not indicate the thickness of the drift, nor does it reveal the bedrock topography. Nevertheless, geological studies showed that there are several deep and narrow buried valleys in the county. The largest one, being a mile wide and 300 feet deep, which extends north to northwest from Winchester (6) as shown in Figure 10 and 11.



EXPLANATION




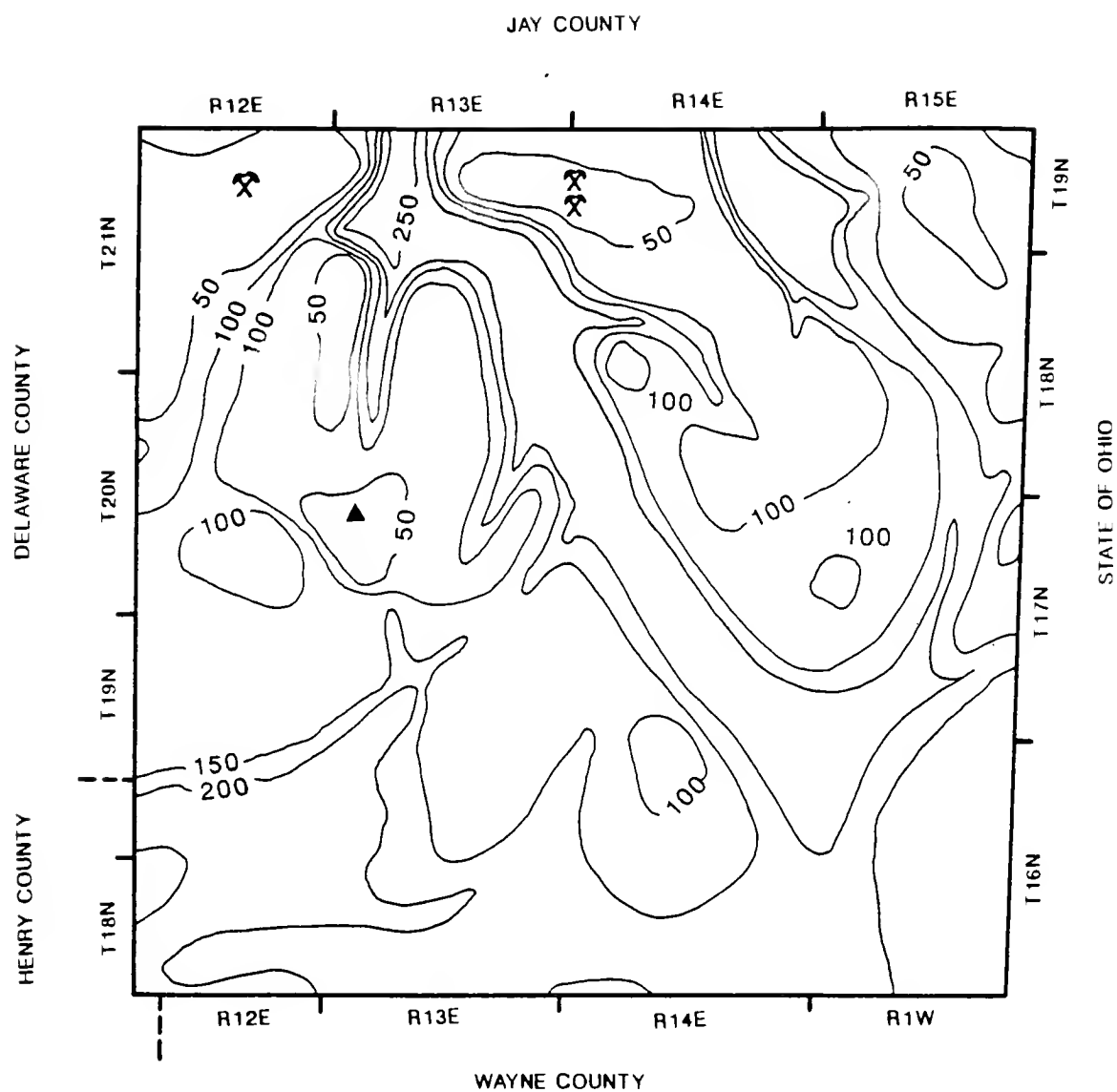

- | | | |
|------------|---|---|
| Silurian |  | Pleasant Mills Formation - Dolomite, Limestone, and Argillaceous Dolomite |
| |  | Salamonie Dolomite, Cataract Formation, and Brassfield Limestone |
| Ordovician |  | Ordovician Rock - Undifferentiated Shale and Limestone |

FIGURE 8. BEDROCK GEOLOGY MAP OF RANDOLPH COUNTY (12)



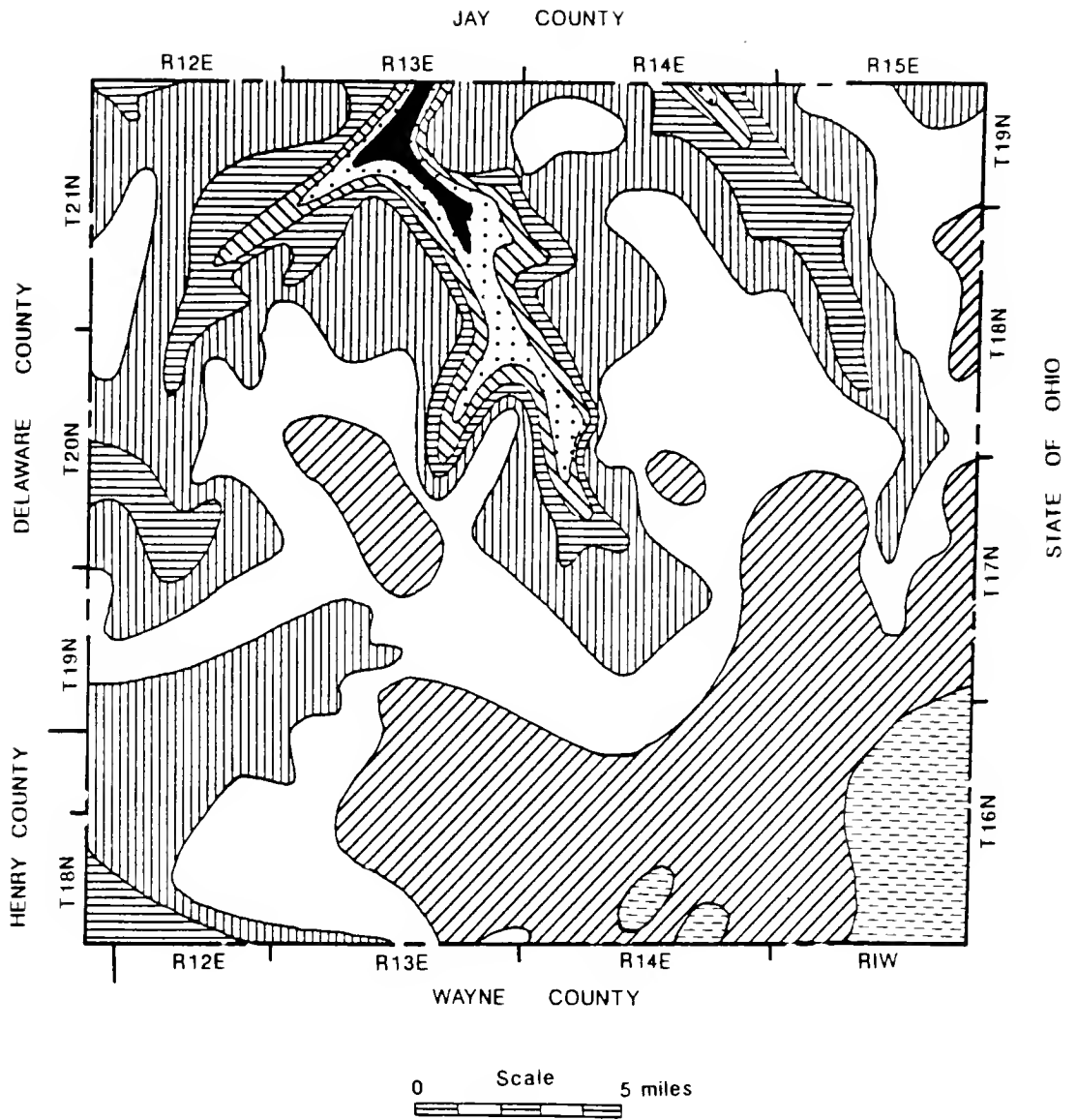
Scale

0 5 miles



Contour Interval = 50 feet

FIGURE 9. THICKNESS OF DRIFT OF RANDOLPH COUNTY (6)



EXPLANATION

Elevation Range in Feet

Contour Interval = 50 Feet









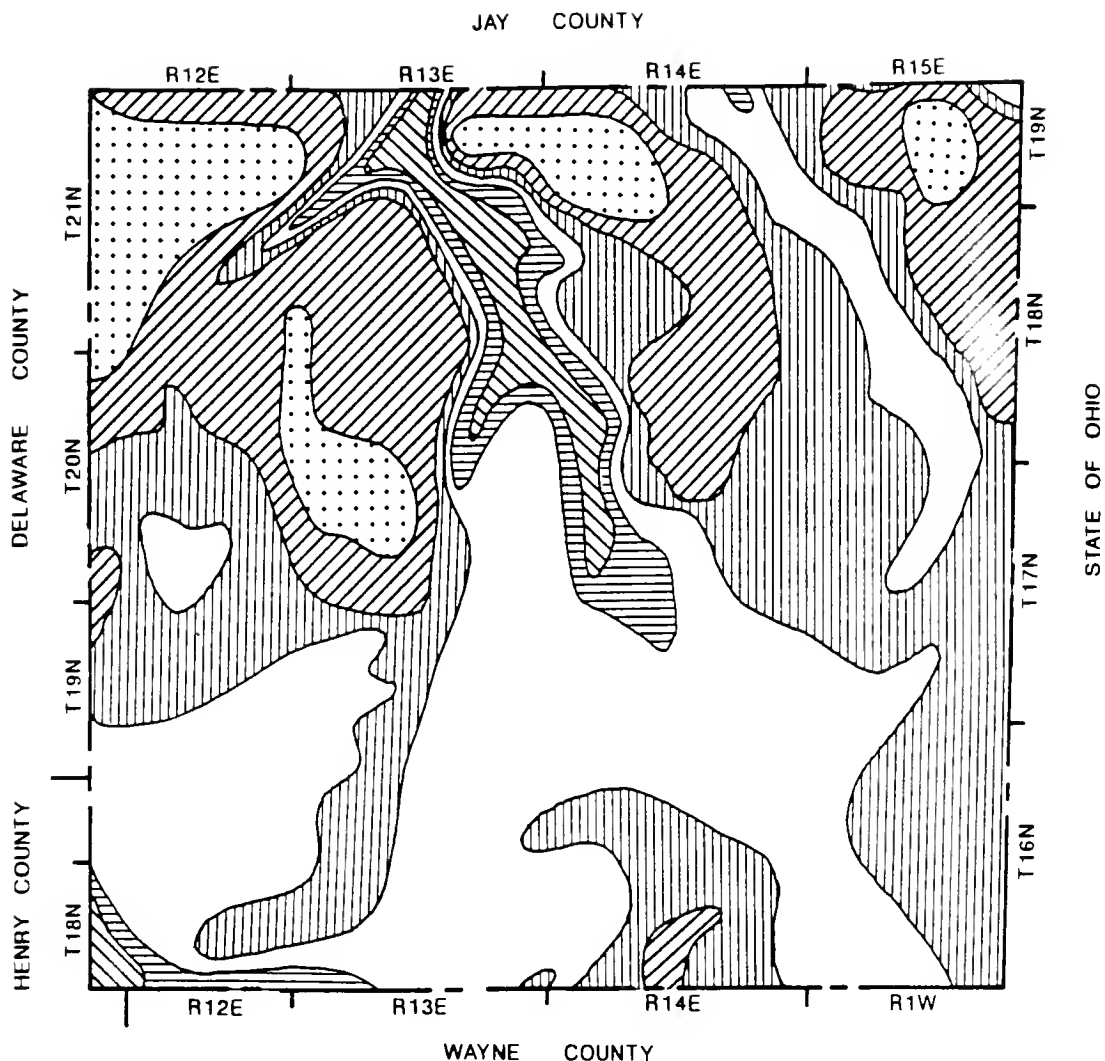
 700 - 750	 850 - 900	 1000 - 1050
 750 - 800	 900 - 950	 1050 - 1100
 800 - 850	 950 - 1000	

FIGURE 10. BEDROCK TOPOGRAPHY OF RANDOLPH COUNTY (17)



0 Scale 5 miles

EXPLANATION

Contour interval = 50 Feet







	0 - 50		100 - 150		200 - 250
	50 - 100		150 - 200		250 - 300

FIGURE 11. THICKNESS OF UNCONSOLIDATED DEPOSITS
IN RANDOLPH COUNTY (18)

BEDROCK GEOLOGY

The bedrock in Randolph County is chiefly Silurian in age. Figure 12 is a map of bedrock geology of Indiana. Randolph County is underlain by rocks of Silurian and Ordovician ages as already shown in Figure 8. The figure illustrates the disposition of the bedrock units as they would appear today if there were no unconsolidated deposits present to cover them.

A generalized geological column of Randolph County is shown in Figure 13. The immediate bedrock underneath the glacial drift is Silurian limestone except for some localities where the deeply buried valleys cut down as much as 300 feet into the shale of Ordovician Age. Surface outcrops are few, usually being encountered near Ridgeville along the Mississinewa River and at Maxville on the White River.

The boundary between Ordovician and Silurian rocks is usually difficult to be recognized although marked by an unconformity (13). Near the base of the Silurian rocks is Brassfield Limestone. It is a medium to coarse-grained fossiliferous limestone having thickness averaging 12 feet for many of the places in northern Indiana.

The Cataract Formation, recognized only in northeast Indiana, overlies the Brassfield Limestone. Lithologically, the Cataract Formation can be divided into three members. However, the three members can not be recognized south of Adams County (20). Where it is undivided, the Cataract Formation is generally a gray or tannish gray dolomite.

Overlying the Cataract Dolomite is Salamonie Dolomite. In northern Indiana, the Salamonie Dolomite has a vertical cutoff boundary with the upper part of the Cataract Dolomite, so that the lower Salamonie rocks in northwestern Indiana are equivalent to the upper Cataract rocks of northeastern Indiana (20). There are two principal lithologies of Salamonie Dolomite. The lower rocks consist of fine-grained argillaceous limestone dolomite, and dolomitic limestone, whereas the upper rocks consist of whitish coarser-grained bioclastic

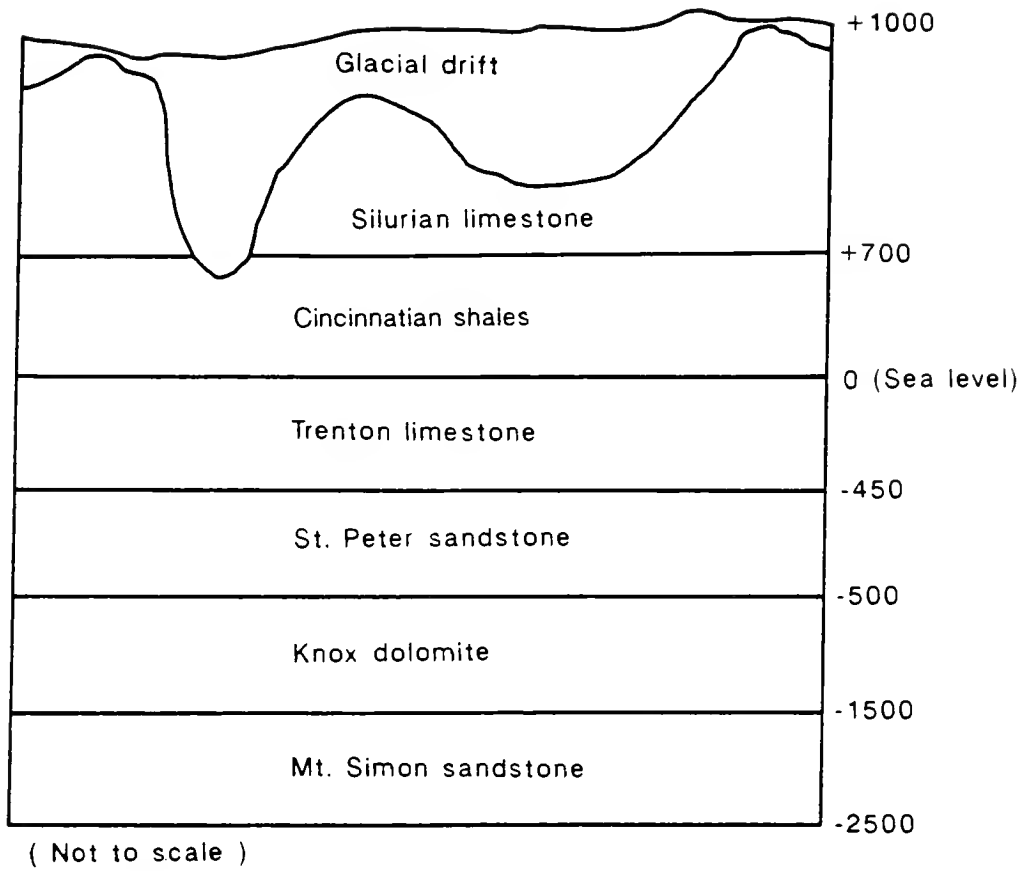


FIGURE 13. GENERALIZED GEOLOGIC COLUMN
OF RANDOLPH COUNTY (6)

vuggy dolomite (20). Color is variable. In the areas where the Salamonie Dolomite is exposed at the bedrock surface, it is usually light-colored (13). One of the principal reference sections is located at the Meshberger Bros. Stone Corp. quarry near Ridgeville of Randolph County.

The Pleasant Mills Formation, dominated by dolomite, limestone, and argillaceous dolomite, overlies the Salamonie Dolomite. It contains three members, namely the Limberlost Dolomite member, the Waldron member, and the Louisville member in ascending order (14). The Limberlost Dolomite is light-brown, micritic to fine-grained dolomite with varying thickness such as zero to 70 feet. In the middle part of the formation is found the Waldron member. It is chiefly shales interbedded with fossil-bearing limestone and silt (15). Overlying it is the Louisville member. The member is composed of light-colored to brown, fine-grained, argillaceous limestone and dolomitic limestone. Chert is common (20).

PLEISTOCENE GEOLOGY

The Pleistocene sediments in Indiana are of continental origin rather than marine origin. Therefore, they are less homogeneous and continuous. The unconsolidated deposits encountered in Randolph County are illustrated in Figure 14. These sediments are of Wisconsinan and Recent stages.

The glacial drift of Wisconsin age is present at the surface throughout Randolph County except in most river valleys where it is overlain by Recent alluvium. Those materials deposits by earlier glaciers are not distinguishable at the surface now. The relationships between unconsolidated deposits are shown in Figure 15.

As noted earlier, the result of Wisconsinan glaciation is mainly a series of ground moraines and ridge moraines in Randolph County. Two end moraines, the Mississinewa end moraine and the Union City end moraine (22), extend across the northern portion of the county

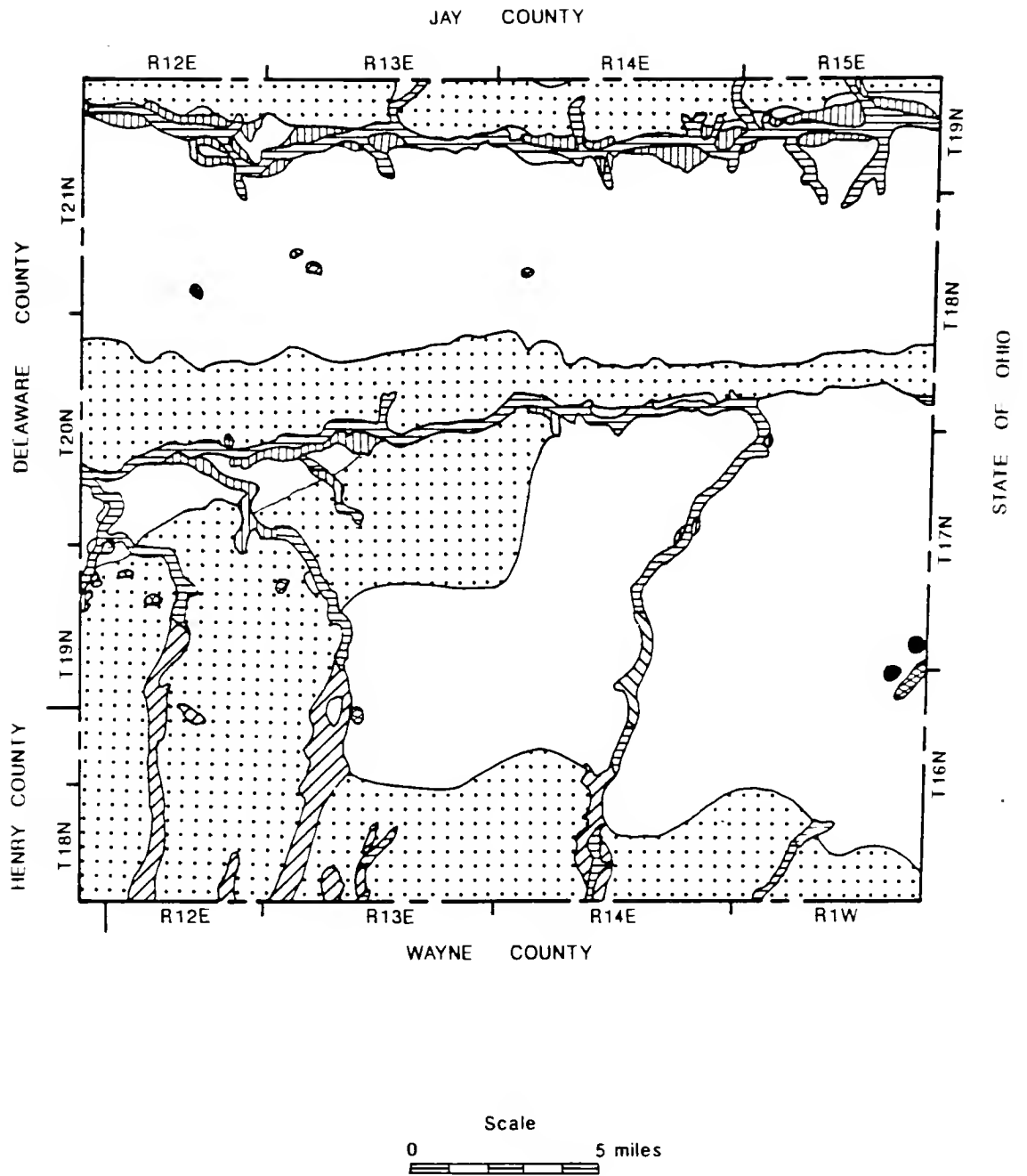


FIGURE 14. UNCONSOLIDATED DEPOSITS OF RANDOLPH COUNTY (21)

EXPLANATION

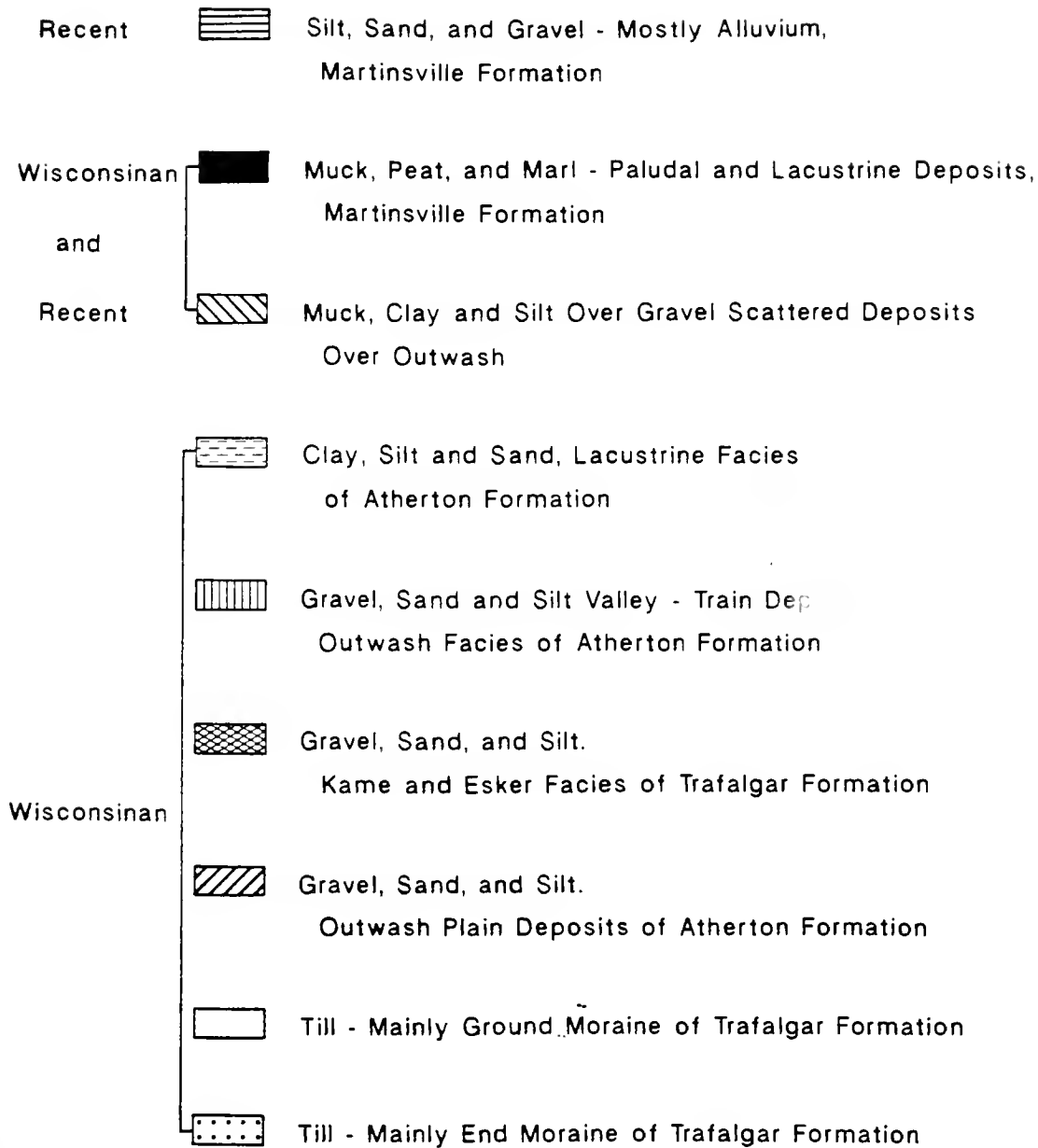
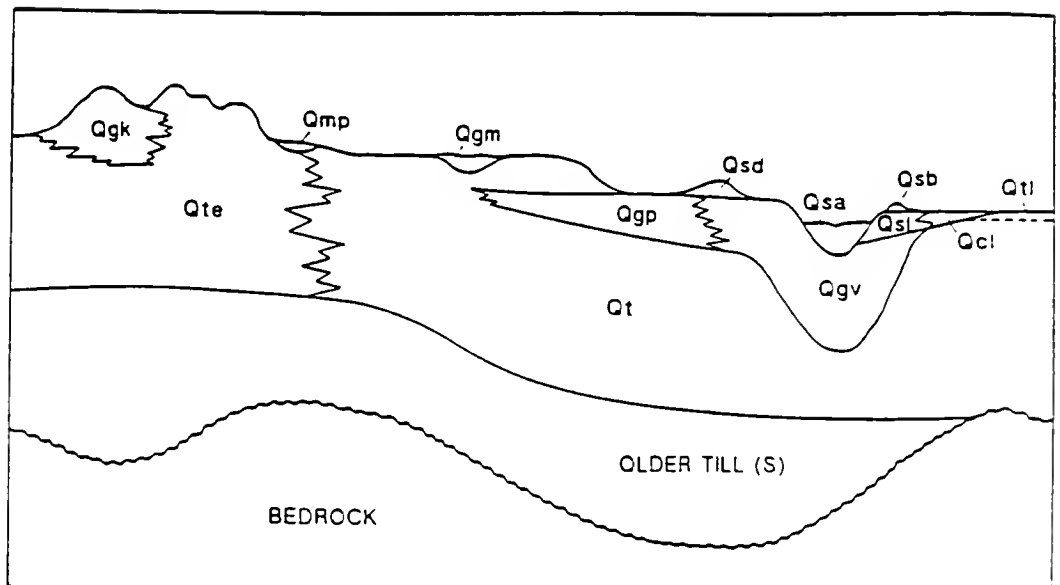


FIGURE 14. UNCONSOLIDATED DEPOSITS OF RANDOLPH COUNTY
(CONTINUED).



EXPLANATION

Quaternary	Qsa	Silt, sand, and gravel
	Qmp	Muck, peat, and marl
	Qgm	Muck, clay, silt, and gravel
	Qcl/Qsl	Clay, silt, and sand
	Qsd/Qsb	Sand
	Qgv/Qgp	Gravel, sand, and silt
	Qgk	Gravel and sand
	Qt/Qte	Till

FIGURE 15. SCHEMATIC SECTION SHOWING RELATIONSHIPS OF UNCONSOLIDATED DEPOSITS (18)

from east to west. The former, which is located on the northern boundary of Randolph County, is distributed along the northern bank of the Mississinewa River, whereas the latter is along that of the White River in Randolph County. Tills of the Trafalgar Formation are most common. They are primarily calcareous conglomeratic mudstones. Lenses of silt, sand, and gravel are also present in the Formation (22).

The Trafalgar Formation is overlain by the Atherton Formation. The Atherton Formation is a deposit of gravel, sand, silt, and clay derived from glacial outwash. Four facies are identifiable as Atherton Formation, but only two exist in the Randolph County, namely lacustrine facies and outwash facies. In general, the sediments of lacustrine facies are finer than those of outwash facies because of different depositional environments. The latter is deposited in streams filled by meltwater current, whereas the former is laid down in ponded valleys.

The youngest sediment in Randolph County is the Martinsville Formation. It is deposited by the modern streams, small lakes and sloughs. Silt, sands, and gravels are most commonly found. The Martinsville Formation includes two facies. One is associated with flood plain deposition and referred as Alluvial facies, the other is essentially formed in still water and named Paludal facies (22). The Alluvial facies contains silt, sand, and gravel, and the Paludal is rich in organic matter. The Paludal facies is highly fossiliferous. Peat in the Martinsville Formation, containing abundant plant remains but rare mollusks, exist in a few locations.

The thickness of unconsolidated deposits is already shown in Figure 11. As noted earlier, the thickest deposits coincide with the deeply buried valleys in the county.

LANDFORM-PARENT MATERIAL REGIONS

The soils of Randolph County are primarily from unconsolidated sediments. These soils are mapped into five groups and associated subgroups for the engineering purpose. The five parent material units are glacial drift, glacial-fluvial drift, fluvial drift, lacustrine drift, and cumulose drift.

Each of the landform-parent material regions is characteristically identified by its surface texture, overall extent, and soil profiles. Available boring log data are collected in Appendix A. Classifications of the soils according to the American Association of State Highway and Transportation Officials (AASHTO) system are given along with the textures in terms of the designation adopted by the U.S. Department of Agriculture. In addition, the physical, chemical and engineering properties of the soils can be found in Appendices B and C.

The engineering considerations for each parent material unit are discussed here. For specific and detailed information, the reader should consult the boring reports listed in the references. This report only provides general information, and is not intended to replace site investigation for any engineering project.

GLACIAL DRIFT

The majority of the area in Randolph County is covered by glacial drift. The ridge moraine and ground moraine are the two parts of the glacial drift.

Ground Moraine

Ground moraine, a poorly sorted mixture of gravel, sand, silt, and clay, occupies the largest portion of the county. These sediments are deposited by Wisconsin glaciers. The surface is level to gentle rolling, sometimes broken by river courses or low knolls. Moraine is

likely to be poorly drained. Therefore, depressions where organic topsoils accumulated can be found on both ground moraine and ridge moraine (23-26). C-type gullies and V-type gullies can be found. The former is an indication of soils rich in clay or silty clay, whereas the latter is common in coarsed-grained soils such as sand and gravel.

There are three types of general soil profiles occurring in ground moraine. All of them are developed from underlying glacial tills. The surface soils of high areas, which have an elevation greater than 1075 feet above sea level, usually consist of loam, clay, silt loam, silty clay loam or silty clay, underlain by subsurface soils of loam, clay, sand, clay loam, silt loam, or silty clay. Among these soils, the thickness of clay layer may be as large as 9 feet. Occasionally, gravel is encountered at a depth of 6.4 feet.

The general soil profile of low areas, whose altitude is less than 1075 feet, is similar to that of high areas. The topmost two feet of soils contain silty clay, silt loam, clay loam, silty clay loam, and sometimes sand and gravel. Marl is present from 3 to 6.5 feet in some places. In addition, the thickness of the soil in low areas is usually thinner than that of high areas. Therefore, the underlying limestone is encountered at 3.5 feet in some localities.

The typical profile of highly organic topsoil features a surface layer of highly organic matter in loam ranging from 0 to 2.5 feet in thickness. The underlying material is similar to that of low areas. The thickness of the soils is also thin. The limestone bedrock appears at relatively shallow depth.

Boring numbers 1-43, 45-47, 59, 61-69, 71-73, 75, 79-82, 86-93 are located on ground moraine.

Agricultural soil series include Blount, Celina, Crosby, Glynwood, Losantville, Miami, Morley, Pewamo, Treaty, and Wallkill.

Ridge Moraine

Ridge (end) moraine covers the second largest area of Randolph County. Its texture is very similar to ground moraine, a poorly sorted mixture of gravel, sand, silt, and clay, thus making it difficult to distinguish between ridge moraine and ground moraine. Usually, the boundary is defined by a topographic break, and ridge moraine has more rugged topography associated with it (14, 24). In addition, ridge moraine usually has greater local relief than ground moraine.

The distribution of ridge moraine in Randolph County generally coincides with local watershed divides. Two major ridge moraines are found in Randolph County, the Mississinewa end moraine and the Union City end moraine. The Mississinewa end moraine is located at the northern boundary of the county, bounded by the Mississinewa River to the south, and features a swell and sag topography (15). The Union City end moraine extends from east to west throughout the central portion of the county along the West Fork of the White River. It rises above the adjacent plains a few tens of feet and has widths ranging from 1 to 3.5 miles.

There are three typical soil profiles for ridge moraines. In high areas the surface layer consists of 0.5-1.8 feet of silt loam, followed by subsoil of silty clay, clay, clay loam, or silty clay loam. The profile in low area features a surface layer of organic material in silty clay ranging from 0 to 0.6 feet. The underlying soils are silty clay, clay, clay loam, and silty clay loam.

The profile common to areas of highly organic top soil in ridge moraine is very similar to that of ground moraines except that limestone bedrock is deeper than 9 feet.

The typical agricultural soil series found in ridge moraine are Blount, Celina, Crosby, Glynwood, Morley, Losantville, and Treaty.

Soil borings numbered 83-85 are located in ridge moraine.

Engineering Considerations in Glacial Drift

The typical engineering properties of glacial drift are poor drainage, low permeability and susceptibility to frost action.

Frost action will cause the volume of the soil to expand 10% or more upon freezing. The expansion is usually not uniform, thus causing serious damage to highway pavements and structures. Moreover, during the spring thaw the water content in the soil is increased by the melted ice lenses. This will weaken the soil and create additional damage to the pavements (27).

To avoid frost action, the material under highway should be drained and granular. Utilities lines and building footings should be placed well below the frost line (28).

Another highway pavement problem is pavement pumping. Pumping is common to rigid pavements over ground moraine (25). Usually soil particles are carried out from beneath the pavement by the ejection of water due to traffic loading (9). Thus, cavities are formed underneath the pavements and cracking and faulting follow. Again, pumping is restricted to poorly drained areas. The damage can be reduced by replacing the fine-grained soils by drained granular ones.

The soils on glacial drift usually have high water contents. Therefore, it may be difficult to compact the soil to required levels. If too great a compaction energy is applied, the soil will actually become weaker. This is called overcompaction (27).

The soils having high organic contents usually have very low strength and high compressibility. Elevated structures and highways are preferred.

GLACIAL-FLUVIAL DRIFT

Outwash plain is the only recognized division of glacial-fluvial drift in Randolph County.

Outwash Plain

Outwash plains are broad plains formed by meltwater currents flowing from the glacier. The soils, consisting of silt, sand, and gravels, are highly stratified. The outwash plains are also affected by the erosion and deposition actions of modern streams because the streams sometimes flow in abandoned channel of outwash plain (14, 29).

The soils encountered in outwash plain are loam and clay loam, underlain by sand and gravel, which in turn underlain by limestone. The agricultural soil series include Westland and Sleeth series.

No soil borings were made in outwash plains.

Engineering Considerations in Glacial-Fluvial Drift

The textures of outwash deposits are usually medium to coarse-grained, and segregated into distinct phases. In general, the outwash plain provides adequate support for light to moderately loaded buildings in the sandy phase (29). Also, it is a good potential source for construction materials such as sand and gravels.

The permeability of the soils are high. This should be taken into account when planning sanitary facilities and landfill sites.

FLUVIAL DRIFT

Fluvial drift appears in two landforms in Randolph County. They are flood plain and terrace.

Flood Plain

Flood Plains are distributed along major rivers and tributaries in Randolph County. All of them are narrow and restricted in aerial extent. Soils of flood plain generally are adjacent to the streams and in the low areas away from the streams.

The soil profile of flood plains varies from place to place. The surface layer is clay, loam, silt loam, clay loam, silty clay loam, sand, or gravel, while the subsurface soil is silt loam, clay, silty clay, loam, silty clay loam, sand, or gravel. The agricultural soil series developed on flood plains are Allison Variant, Eel, Saranac, Sloan series.

Soil borings located in flood plain were numbers 44, 58, 60, 74, 94, 142.

Terrace

Terraces are distributed along the stream valleys of the three major river systems. A typical profile has a surface layer of loam 1 to 2 feet in thickness, while the subsurface soils consists of clay loam, sand, and gravel.

The agricultural soil series common to terrace are Eldean and Fox series.

Boring numbers 143-157 are located in terrace.

Engineering Considerations in Fluvial Drift

Fluvial deposits are usually layered and highly variable (29). The permeability in the horizontal direction tends to be much greater then the vertical direction. Furthermore, the permeabilities in the surface layers are usually lower compared with the sublayers. Flooding, differential settlements and low shear strength are greatest concerns in the flood plain.

For terraces, high potential of erosion is the major engineering problems, especially on the side slopes. Circular types of slope failure are common after heavy rainfall.

The ground water table is close to the surface in fluvial drift. This makes excavation difficult. A dewatering scheme is recommended.

LACUSTRINE DRIFT

One type of lacustrine drift, the lacustrine plain, is encountered in Randolph County.

Lacustrine Plain

The lacustrine plains are numerous and wide spread in Randolph County. Almost all the lacustrine plains are encountered to the south of the West Fork of the White River. They are usually ponded and poorly drained. Therefore, the surface layer of lacustrine plains usually contains muck and highly organic materials. In addition, soils of silty clay loam and silt loam can be found at greater depth.

The agricultural soil series common to lacustrine plain is Patton.

Soil borings 70, 76-78 are located in lacustrine plain.

Engineering Considerations in Lacustrine Drift

The soils in lacustrine plain are moist in nature since the area is usually subjected to ponding. The soils have low shear strength and high compressibility. The soil is also poorly drained. Therefore, pavement pumping is possible as in the case of glacial drift. Slope failure is not usual, since slopes with steep angle are rare. Also, frost action is one of the major concerns in lacustrine plains.

CUMULOSE DRIFT

Cumulose drift occurs in the form of muck basins in Randolph County.

Muck Basin

Muck basins are deposits associated with muck and highly organic matters. The size of muck basin varies. The thickness of muck also varies. Usually the larger the basin, the thinner the muck. On the other hand, muck layer as thick as 9 feet can be found. Muck basins are underlain by loam, silty clay, silt loam, clay, clay loam, and silty clay loam. Sand and gravel sometimes can be found at a depth greater than 3.4 feet.

The agricultural soil series associated with muck basin are Carlisle and Linwood.

No soil boring reports are available for muck basins at the time of preparing this report.

Engineering Considerations in Cumulose Drift

The characteristics of muck basin are high organic content, high water content, high porosity, high compressibility, low permeability, and low strength. Therefore, the muck basin is unsuited for roads or buildings. Usually, constructions on muck basin are avoided. However, if economically feasible, the soils in muck basin can be replaced by soils with adequate engineering properties.

MISCELLANEOUS

Gravel Pits

A number of gravel pits can be found in Randolph County. Some of them are active, and some of them are abandoned. Sand and gravel are mined from gravel pits. Each year a vast amount of sand and gravel is used in construction projects such as dams, highways, bridges, foundations, and buildings. Sand and gravel are classified according to their grain sizes. Loosely speaking, the coarse-grained soil with particle size greater than 2 mm are termed gravels, whereas sand is defined as soils with grain size less than 2mm.

Gravel pits are usually abandoned after the underlying sand and gravel are mined. However, sometimes the abandoned excavation sites are reclaimed for recreation purpose or housing development (30).

Marsh and Swamps

A few marshes are seen around the county and are shown on the Engineering Soil Map. The marsh and swamp soils are characterized by their low strength and high compressibility. Furthermore, they are generally corrosive (highly acidic) to foundation material (29)

SUMMARY OF ENGINEERING CONSIDERATIONS IN RANDOLPH COUNTY

Table 5 is the summary of engineering considerations for different landform-parent material regions in Randolph County. Each landform-parent material and its associated engineering problems are included in the table. However, the ranking shown in the table is recommended to be used as a general guideline only. Site specific investigation is always needed for any project in Randolph County.

REFERENCES

1. Puetz, C. T., Indiana's County Maps.
2. Neely, T., "Soil Survey of Randolph County, Indiana", United States Department of Agriculture, Soil Conservation in Cooperation with Purdue University Agricultural Experimental Station and Indiana Department of Natural Resources, Soil and Water Conservation Committee, 1987.
3. Hittle, J. H., "Population Trends for Indiana Counties, Cities, Towns 1970-1980," Highway Extension and Research Project for Indiana Counties, 1981.
4. Scheeringa, K., "Computer Printout of 30-year Normals (1951-1980) of Temperature and Precipitation for Randolph County Recorded at Farmland, 1991.
5. Magnusson, L. R., and Montano, P., "Drainage Map of Randolph County, Indiana," Joint Highway Research Project, Purdue University, West Lafayette, Indiana, 1952.
6. Uhl, J.E., "Water Resources of Randolph County with Emphasis on Ground-Water Availability", State of Indiana, Department of Natural Resources, Division of Water, 1969.
7. Perry, J. I., et al., "Indiana's Water Resources," Indiana Flood Control and Water Resources Commission, Bulletin No. 1, 1951.
8. "1989 Water Use Summary for Randolph County," Computer Printouts, County Water Use Summary System, Division of Water, Department of Natural Resources, Indianapolis, Indiana.
9. Belcher, D. T., Gregg, L. E., and Woods, K. B., "The Formation, Distribution and Engineering Characteristics of Soils," Joint Highway Research Project, Highway Research Bulletin Number 10, Purdue University, West Lafayette, Indiana, 1943.
10. "Map of Indiana Showing Physiographic Units and Glacial Boundaries," Modified from Indiana Geological Survey Report of Progress, No. 7, Figure 1.
11. "Regional Topographic Map, Muncie Sheet," Prepared by the U. S. Army Topographic Command, Washington, D. C., 1954, Revised by the U. S. Geological Survey, 1977, Map Edited 1978.
12. Burger, A. M., Forsyth, J. L., Nicoll, R. S., and Wayne, W. J., "Geological Map of the Muncie Quadrangle, Indiana and Ohio, Showing Bedrock and Unconsolidated Deposits," Regional Geological Map No. 5, Muncie Sheet, Part A, Indiana Geological Survey, Department of Natural Resources, Bloomington, Indiana, 1971.
13. Pink, A. P., and Shaver, R. H., "The Silurian Formations of Northern Indiana," Indiana Department of Conservation, Geological Survey Bulletin 32, Bloomington, Indiana, 1964.

14. Barbara, I. S., "Engineering Soils Map of Henry County, Indiana," Joint Highway Research Project, JHRP-90-3, School of Civil Engineering, Purdue University, West Lafayette, Indiana, 1990.
15. Arvind, C., "Engineering Soils Map of Jay County, Indiana," Joint Highway Research Project, JHRP-91-4, School of Civil Engineering, Purdue University, West Lafayette, Indiana, 1991.
16. Shurig, D. G., "Engineering Soils Map of Delaware County, Indiana," Joint Highway Research Project, JHRP-74-7, School of Civil Engineering, Purdue University, West Lafayette, Indiana, 1974.
17. Gray, H. H., "Map of Indiana Showing Topography of the Bedrock Surface," Miscellaneous Map No. 35, Indiana Geological Survey, Department of Natural Resources, Bloomington, Indiana, 1982.
18. Gray, H. H., "Map of Indiana Showing Thickness of Unconsolidated Deposits," Miscellaneous Map No. 37, Indiana Geological Survey, Department of Natural Resources, Bloomington, Indiana, 1983.
19. Patton, "Bedrock Geology of Indiana," 1955.
20. Shaver, R. H., et al., "Compendium of Paleozoic Rock-Unit Stratigraphy in Indiana – A Revision," Indiana Department of Natural Resources, Geological Survey Bulletin 59, Bloomington, Indiana, 1986.
21. Burger, A. M., Forsyth, J. L., Nicoll, R. S., and Wayne, W. J., "Geological Map of the Muncie Quadrangle, Indiana and Ohio, Showing Bedrock and Unconsolidated Deposits," Regional Geological Map No. 5, Muncie Sheet, Part B, Indiana Geological Survey, Department of Natural Resources, Bloomington, Indiana, 1971.
22. Wayne, W. J., "Pleistocene Formations in Indiana," Indiana Department of Conservation, Geological Survey Bulletin No. 25, Bloomington, Indiana, 1963.
23. Peck, R. B., Hanson, W. E., and Thornburn, T. H., Foundation Engineering, 2nd Edition, 1973.
24. Gefell, E. M., "Engineering Soils Map of Huntington County, Indiana," Joint Highway Research Project, JHRP-85-15, School of Civil Engineering, Purdue University, West Lafayette, Indiana, 1985.
25. Chaturvedi, A., "Engineering Soils Map of Adams County, Indiana," Joint Highway Research Project, JHRP-89-15, School of Civil Engineering, Purdue University, West Lafayette, Indiana, 1989.
26. Garrigus, A., "Engineering Soils Map of Blackford County, Indiana," Joint Highway Research Project, JHRP-90-1, School of Civil Engineering, Purdue University, West Lafayette, Indiana, 1990.

27. Holtz, R. D., and Kovacs, W. D., An Introduction to Geotechnical Engineering, Prentice-Hall, Inc., 1981.
28. Bowles, J. E., Foundation Analysis and Design, Fourth Edition, McGraw-Hill, Inc., 1988.
29. Hunt, R. E., Geotechnical Engineering Investigation Manual, McGraw-Hill, Inc., 1984.
30. Carr, D. D., and Webb, W. M., "Sand and Gravel Resources of Indiana," Department of Natural Resources, Geological Survey Bulletin 42-D, Bloomington, Indiana, 1970.
31. "Geotechnical Investigation, Project No. RS-3568(1), Structure No. 1-68-6093, SR 1 over Elkhorn Creek, Randolph County, Indiana," Prepared by H. C. Nutting Company, Cincinnati, Ohio, July 1988.
32. "Geotechnical Investigation, Project No. RS-7568, CR 300W from US 36 to CR 700S, Randolph County, Indiana," Prepared by Engineering & Testing Services, Inc., Indianapolis, Indiana, 1984.
33. "Subsurface Investigation and Soil Recommendations, Project No. RS-7568, County Road 300 West, Randolph County, Indiana," Prepared by Alt & Witzig Engineering, Inc., 1983.
34. "Geotechnical Investigation, Project No. BRZ-9968, Structure No. Randolph 10639, CR 675W over White River, Randolph County, Indiana," Prepared by Engineering & Testing Services, Inc., Indianapolis, Indiana, 1987.
35. "Subsurface Exploration, RS-3768, Structure No. 1-68-6091, SR 1 over White River, ATEC Job No. D76901, Randolph County, Indiana," Prepared by Atec Associates, 1977.
36. "Subsurface Exploration, RS-3768, Structure No. 1-68-6091, SR 1 over White River, ATEC Job No. D77884, Randolph County, Indiana," Prepared by Atec Associates, 1977.
37. "Report of Roadway Soil Survey, S-Project No. 483(4), P.E. West Section, S-Project No. 483(6) Construction, SR 28 from Deerfield to 0.4 mile east of CR 400E, Randolph County, Indiana," Prepared by ISHC-Division of Materials and Tests, Soils Department, 1973.
38. "Subsurface Investigation and Soil Recommendations, Project No. RS-6268(1), Structure No. Randolph 10297, CR 1100S over Greens Fork Creek, Randolph County, Indiana," Prepared by Alt & Witzig Engineering, Inc., Indianapolis, Indiana, 1985.
39. "Subsurface Investigation and Soil Recommendations, Project No. RS-3768(2), Structure No. 1-68-7155, SR 1 over Cabin Creek, Randolph County, Indiana," Prepared by Alt & Witzig Engineering, Inc., Indianapolis, Indiana, 1986.

40. "Subsurface Investigation and Soil Recommendations, Project No. BRZ-9968, Structure No. Randolph 10342, CR 375W over White River, Randolph County, Indiana," Prepared by Alt & Witzig Engineering, Inc., Indianapolis, Indiana, 1984.
41. "Subsurface Investigation and Soil Recommendations, Project No. BRZ-9968, Structure No. Randolph 10454, CR 900W over White River, Randolph County, Indiana," Prepared by Alt & Witzig Engineering, Inc., Indianapolis, Indiana, 1985.
42. "Subsurface Investigation and Soil Recommendations, Project No. BRZ-9968, Structure No. Randolph 10640, CR 400E over White River, Randolph County, Indiana," Prepared by Alt & Witzig Engineering, Inc., Indianapolis, Indiana, 1987.
43. "Subsurface Investigation and Soil Recommendations, Project No. RS-8568, Structure No. Randolph 10296, CR 300E over White River, Randolph County, Indiana," Prepared by Alt & Witzig Engineering, Inc., Indianapolis, Indiana, 1982.
44. "Subsurface Investigation and Soil Recommendations, Project No. BRM-P586, Structure No. Randolph 10558, Franklin Street over Salt Creek, Randolph County, Indiana," Prepared by Alt & Witzig Engineering, Inc., Indianapolis, Indiana, 1986.
45. "Subsurface Exploration, F-100-3(I), Structure No. 32-68-6493, SR 32 over Salt Creek, ATEC Job No. D77884, Randolph County, Indiana," Prepared by Atec Associates, Indianapolis, Indiana, 1977.
46. "Geotechnical Investigation, Project No. F-100-4(1), Structure No. 32-68-7275, SR 32 over Price Ditch, Randolph County, Indiana," Prepared by Engineering & Testing Services, Inc., Indianapolis, Indiana, 1987.
47. "Report of Roadway Soil Survey, S-Project No. 483(4), P.E. East Section, S-Project No. 483 Construction, SR 28 from 0.4 mile east of CR 400E to Union City, Randolph County, Indiana," Prepared by ISHC-Division of Materials and Tests, Soils Department, 1973.
48. "Report of the Investigation of Soft Embankment & Foundation Materials, RS-Project No. 3768, Structure No. 1-68-6091, SR 1 over White River, Randolph County, Indiana," Prepared by Indiana State Highway Commission, Division of Materials and Tests, Soils Department, 1977.
49. Arvin, D. V., "Statistical Summary of Streamflow Data for Indiana," U.S. Geological Survey Open-File-Report 89-62, Prepared in Cooperation with the Indiana Department of Natural Resources, Indianapolis, Indiana, 1989.

APPENDIX A

CLASSIFICATION TEST RESULTS FOR SELECTED
ENGINEERING PROJECTS IN RANDOLPH COUNTY (31-48)

Appendix A1: Continued.

Boring No.	Project	Sample No.	Station No.	Offset Ft.	Ground Elevation Ft.	Sample Depth Ft.	Soil Description		Blow per Ft.	Grain Size			LL	PL	PI
							Texture	AASHTO		Gravel	Sand	Silt			
10		1	87+00	CL	1013.3	0.0-0.6	Silty loam	-	-						
		2	"	"	"	0.6-1.5	Loam	-	-						
		3	"	"	"	1.5-2.5	Clay	A-7-6	-						
		4	"	"	"	2.5-5.5	Clay loam w/ some gravel	-	-						
		5	"	"	"	5.5-8.0	Sandy clay w gravel	-	-						
11		1	95+00	CL	1003.1	0.0-0.6	Silty loam	-	-						
		2	"	"	"	0.6-1.2	Silty clay loam	-	-						
		3	"	"	"	1.2-3.0	Clay	-	-						
		4	"	"	"	3.0-3.5	Sandy Clay loam	-	-						
		5	"	"	"	3.5-6.0	Sandy clay w gravel	-	-						
12		1	106+70	CL	1019.1	0.0-0.8	Silty loam	-	-						
		2	"	"	"	0.8-1.7	Silty clay loam	-	-						
		3	"	"	"	1.7-3.5	Clay	A-7-6	-						
		4	"	"	"	3.5-4.0	Silty clay loam	-	-						
		5	"	"	"	4.0-6.0	Silty clay loam w/some gravel	-	-						

Appendix A1: Continued.

Boring No.	Project	Sample No.	Station No.	Offset Ft.	Ground Elevation Ft.	Sample Depth Ft.	Soil		Description	Blow per Ft.	Grain Size			LL	PL	PI
							Texture				Gravel	Sand	Silt			
16		1	139+50	CL	1022+0	0.0-0.8	Silty clay loam		-	-						
		2	"	"	"	0.8-1.5	Silty clay		-	-						
		3	"	"	"	1.5-3.0	Clay w/some sand		-	-						
		4	"	"	"	3.0-4.5	Sandy clay		-	-						
		5	"	"	"	4.5-6.0	Clay		-	-						
17		1	150+00	CL	1031.2	0.0-0.9	Silty loam		-	-						
		2	"	"	"	0.9-1.5	Silty clay loam		-	-						
		3	"	"	"	1.5-2.5	Silty clay		-	-						
		4	"	"	"	2.5-6.0	Clay		-	-						
18		1	162+40	CL	1027.8	0.0-0.7	Silty loam		-	-						
		2	"	"	"	0.7-1.0	Silty clay loam		-	-						
		3	"	"	"	1.0-2.5	Clay		-	-						
		4	"	"	"	2.5-3.5	Silty Clay		-	-						
		5	"	"	"	3.5-4.5	Silty clay w/some grav.		-	-						
		6	"	"	"	4.5-6.0	Clay		-	-						
		7	"	"	"	6.0-7.0	Sandy clay		-	-						

Appendix A1: Continued.

Boring No.	Project	Sample No.	Station No.	Offset Ft.	Ground Elevation Ft.	Sample Depth Ft.	Soil		Description	Blow per Ft.	Grain Size			LL	PL	PI
							Texture	AASHTO			Gravel	Sand	Silt	Clay		
19		1	173+00	CL	1034.8	0.0-0.8	Silty loam	-	-	-						
		2	"	"	"	0.8-2.0	Silty clay	-	-	-						
		3	"	"	"	2.0-3.0	Clay loam w/ trace gravel	-	-	-						
		4	"	"	"	5.0-6.0	Silty loam w/ trace gravel	-	-	-						
20		1	182+00	CL	1033.8	0.0-0.7	Silty loam	-	-	-						
		2	"	"	"	0.7-2.0	Silty clay	-	-	-						
		3	"	"	"	2.0-6.0	Clay	-	-	-						
21		1	194+74	CL	1028.6	0.0-1.0	Silty loam	-	-	-						
		2	"	"	"	1.5-2.5	Silty clay	-	-	-						
		3	"	"	"	2.5-3.0	Clay w/trace sand	-	-	-						
		4	"	"	"	4.0-5.0	Sandy clay	-	-	-						
		5	"	"	"	5.0-5.5	"	-	-	-						
22		1	204+00	CL	1036.6	0.0-0.8	Silty loam	-	-	-						
		2	"	"	"	1.0-3.0	Silty clay w/ trace gravel	-	-	-						
		3	"	"	"	4.0-6.0	Silty clay loam w/some gravel	-	-	-						
		4	"	"	"	8.0-10.0	Sandy loam w/ some gravel	-	-	-						

Appendix A1: Continued.

Boring No.	Project	Sample No.	Station No.	Offset Ft.	Ground Elevation Ft.	Sample Depth Ft.	Soil Description		Blow per Ft.	Grain Size				LL	PL	PI
							Texture	AASHTO		Gravel	Sand	Silt	Clay			
		5	204+00	CL	1036.6	11.0-14.0	Clay loam w/ little grav.	-	-							
		6	"	"	"	14.0-16.0	Silty loam	-	-							
23		1	210+00	CL	1016.7	0.0-0.5	Silty loam	-	-							
		2	"	"	"	0.5-1.2	Silty clay	-	-							
		3	"	"	"	1.5-2.0	Sandy clay w/some grav.	-	-							
24		1	218+00	CL	1040.0	0.0-0.8	Silty loam	-	-							
		2	"	"	"	1.0-2.0	Clay	A-7-6	-							
		3	"	"	"	4.0-5.0	Silty clay loam w/little gravel	-	-							
		4	"	"	"	6.0-8.0	Clay loam w/ little grav.	-	-							
		5	"	"	"	10.0-10.5	Sandy loam	-	-							
		6	"	"	"	11.0-12.0	Silty clay loam w/trace gravel	A-7-6	-							
		7	"	"	"	13.0-14.0	Clay w/trace gravel	-	-							
		8	"	"	"	16.0-18.0	Sandy clay loam w/little gravel	-	-							
25		1	218+00	CL	1039+2	1.5-2.5	Clay	A-7-6	-							

Appendix A1: Continued.

Boring No.	Project	Sample No.	Station No.	Offset Ft.	Ground Elevation Ft.	Sample Depth Ft.	Soil Description		Blow per Ft.	Grain Size			LL	PL	PI
							Texture	AASHTO		Gravel	Sand	Silt			
26		1	229+58	CL	1037.3	0.0-0.8	Silty loam	-	-						
		2	"	"	"	1.0-2.0	Clay	A-7-6	-						
		3	"	"	"	2.5-3.0	Silty clay	-	-						
		4	"	"	"	3.0-4.0	Clay loam w/ trace grav.	-	-						
27		1	240+00	CL	1046.1	0.0-0.5	Silty loam	-	-						
		2	"	"	"	0.5-1.5	Clay	A-7-6	-						
		3	"	"	"	2.0-2.5	Silty clay w/trace grav.	-	-						
		4	"	"	"	4.0-5.0	"	-	-						
28		1	246+00	CL	1041.1	0.0-1.0	Clay loam	-	-						
		2	"	"	"	1.2-2.0	Clay	-	-						
		3	"	"	"	5.5-6.0	Silty clay w/trace grav.	-	-						
29		1	259+00	65RT	1041.5	0.0-1.0	Silty clay loam	-	-						
		2SS	"	"	"	1.0-2.5	Silty clay	-	11						
		3SS	"	"	"	3.5-5.0	Silty clay-sandv loam	-	11						
		4SS	"	"	"	6.0-7.5	Sandy clay loam	-	19						
		5SS	"	"	"	8.5-10.0	Clay loam	-	18						
		6SS	"	"	"	11.0-12.5	"	-	16						

Appendix A1: Continued.

Boring No.	Project	Sample No.	Station No.	Offset Fl.	Ground Elevation Fl.	Sample Depth Fl.	Soil		Description	Blow per Ft.	Grain Size			LL	PL	PI
							Texture	AASHTO			Gravel	Sand	Silt	Clay		
29		7SS	259+00	65RT	1041.5	13.5-15.0	Clay loam	-	-	24						
30		1	261+50	50RT	1039.5	0.0-1.0	Silty clay	-	-	-						
		2	"	"	"	1.5-2.5	Clay	-	-	-						
		3	"	"	"	5.5-6.0	Clay w/some gravel	-	-	-						
31		1	261+50	CL	1038.9	0.0-0.8	Clay	-	-	-						
		2	"	"	"	1.0-2.0	"	-	-	-						
		3	"	"	"	6.0-7.0	Clay w/trace gravel	-	-	-						
32		1	262+00	25LT	1038.4	0.0-1.5	Silty clay	-	-	-						
		2	"	"	"	1.5-2.5	Clay	-	-	-						
		3	"	"	"	2.5-3.0	Clay w/marl	-	-	-						
		4	"	"	"	3.0-7.0	Silty clay loam w/marl	-	-	-						
		5	"	"	"	7.0-9.0	Silty clay w/marl	-	-	-						
33		1PT	262+00	25LT	1038.4	3.0-5.0	Silty clay loam w/marl	-	-	-						
		2PT	"	"	"	5.0-7.0	"	-	-	-						
		3PT	"	"	"	7.0-9.0	Silty clay w/marl	-	-	-						
		4PT	"	"	"	9.0-11.0	"	-	-	-						
		5PT	"	"	"	11.0-12.5	Clay	-	-	15						

Appendix A2: Continued.

Boring No.	Project	Sample No.	Station No.	Oftset Ft.	Ground Elevation Ft.	Sample Depth Ft.	Soil		Blow per Ft.	Grain Size			LL	PL	PI
							Texture	Description		Gravel	Sand	Silt			
46		1	333+38	CL	1054.8	1.0-2.0	Sod	-	-						
		2	333+38	CL	1054.8	6.0-7.0	Clay Loam	-	-						
		3	333+38	CL	1054.8	8.0-9.0	Silty Clay Loam w/Sand Lenses	-	-						
		4	333+38	CL	1054.8	10.0-11.0	Sandy Clay Loam	-	-						
47		1	340+00	CL	1059.9	0.0-0.5	Silty Clay Loam	-	-						
		2	340+00	CL	1059.9	2.0-3.0	Clay Loam	-	-						
		3	340+00	CL	1059.9	10.0-11.0	Sandy Clay Loam	-	-						
48		1	347+60	CL	1051.0	0.0-9.5	Silty Clay	-	-						
		2	347+60	CL	1051.0	0.5-2.0	Silty Clay w/Trace Gravel	-	-						
		3	347+60	CL	1051.0	3.5-5.0	Sandy Clay Loam	-	-						
49		1	361+15	CL	1063.3	0.0-0.5	Silty Loam	-	-						
		2	361+15	CL	1063.3	2.0-3.0	Clay Loam	-	-						
		3	361+15	CL	1063.3	6.0-7.0	Clay Loam	-	-						

Appendix A2: Continued.

Boring No.	Project	Sample No.	Station No.	Offset Ft.	Ground Elevation Ft.	Sample Depth Ft.	Soil Description		Blow per Ft.	Grain Size				LL	PL	PI
							Texture	AA SHTO		Gravel	Sand	Silt	Clay			
57		1	434+00	CL	1073.6	0.0-0.5	Silty clay loam	-	-							
		2	"	"	"	2.0-3.0	Clay	-	-							
		3	"	"	"	6.0-7.0	"	-	-							
58		1	445+85	10RT	1075.8	0.0-0.7	Silty clay loam	-	-							
		2	"	"	"	1.0-2.0	Clay loam	-	-							
		3	"	"	"	3.0-4.0	Clay	-	-							
		4	"	"	"	6.0-7.0	Silty loam	-	-							
		5	"	"	"	12.0-13.0	Clay loam w/ trace gravel	-	-							
		6	"	"	"	16.0-17.0	"	-	-							
59		1	445+80	10RT	1075.8	2.5-4.5	Clay	-	3							
		2	"	"	"	12.0-14.0	Clay loam w/ trace gravel	-	4							
60		1	445+80	12RT	1075.8	3.0-5.0	Clay	-	3							
		2	"	"	"	5.5-7.5	Silty loam	-	3							
		3	"	"	"	8.0-10.0	"	-	4							
		4	"	"	"	12.0-14.0	Clay loam w/ trace gravel	-	-							

Appendix A2: Continued.

Boring No.	Project	Sample No.	Station No.	Offset Fl.	Ground Elevation Ft.	Sample Depth Ft.	Soil		Description AASHTO	Blow per Ft.	Grain Size			Distri bution		LL	PL	PI
							Texture				Gravel	Sand	Silt	Clay				
61		1	458+00	CL	1074.8	0.0-0.5	Silty clay loam		-	-								
		2	"	"	"	1.0-3.0	Clay loam		-	-								
		3	"	"	"	4.5-5.5	Silty clay loam		-	-								
62		1	465+00	CL	1071.2	0.0-0.7	Clay loam		-	-								
		2	"	"	"	1.0-2.0	Clay		-	-								
		3	"	"	"	3.0-4.0	"		-	-								
63		1	477+50	15RT	1074.2	0.0-0.8	Silty loam		-	-								
		2	"	"	"	0.8-3.0	Silty clay loam		-	-								
		3	"	"	"	4.0-5.0	Sandy clay loam		-	-								
64		1	485+00	25RT	1074.6	0.0-0.7	Silty clay loam		-	-								
		2	"	"	"	1.0-2.5	"		-	-								
		3	"	"	"	3.0-4.0	Clay loam		-	-								

Appendix A5: C.R. 300 West

Boring No.	Project	Sample No.	Station No.	Offset Ft.	Ground Elevation Ft.	Sample Depth Ft.	Soil		Blow per Ft.	Grain Size				LL	PL	PI
							Texture	Description		Gravel	Sand	Silt	Clay			
76		1SS	11+00	16LT	1174.4	1.0-2.5	Clay	A-7-6(17)	13							
		2SS	"	"	"	3.5-5.0	"	"	7							
		3SS	"	"	"	6.0-7.5	"	"	12							
		4SS	"	"	"	8.5-10.0	"	A-7-6	19							
		Bag	"	"	"	0.5-2.0	"	A-7-6(17)	-	-	18	48	34	45	26	19
77		1SS	15+75	20LT	1167.0	1.0-2.5	Clay	A-7-6	14							
		2SS	"	"	"	3.5-5.0	"	"	17							
		3SS	"	"	"	6.0-7.5	"	"	13							
		4SS	"	"	"	8.5-10.0	"	"	20							
		5SS	"	"	"	13.5-15.0	Clay loam	A-4(1)	34	-	22	49	25	22	17	5
78		1SS	15+75	20RT	1169.2	1.0-2.5	Clay loam	A-4	7							
		2SS	"	"	"	3.5-5.0	"	"	13							
		3SS	"	"	"	6.0-7.5	"	"	18							
		4SS	"	"	"	8.5-10.0	"	"	26							
		5SS	"	"	"	13.5-15.0	Sand	A-2-4(0)	19	-	81	19	19	-	-	-

Appendix A5: Continued.

Boring No.	Project	Sample No.	Station No.	Offset Ft.	Ground Elevation Ft.	Sample Depth Ft.	Soil		Description	Blow per Ft.	Grain Size			LL	PL	PI
							Texture				Gravel	Sand	Silt	Clay		
79		1SS	21+38	24LT	1168.0	1.0-2.5	Clay		A-7-6	4						
		2SS	"	"	"	3.5-5.0	"		A-7-6	10						
		3SS	"	"	"	6.0-7.5	"		A-7-6	15						
		4SS	"	"	"	8.5-10.0	Clay loam		A-4	20						
		5SS	"	"	"	13.5-15.0	"		A-4	34						
80		1SS	21+38	22RT	1167.1	1.0-2.5	Clay loam		A-4	5						
		2SS	"	"	"	3.5-5.0	"		"	21						
		3SS	"	"	"	6.0-7.5	"		"	18						
		4SS	"	"	"	8.5-10.0	Sand		A-2-4	26						
		5SS	"	"	"	13.5-15.0	"		"	24						
81		1SS	24+85	21LT	1169.2	1.0-2.5	Clay loam		A-4	10						
		2SS	"	"	"	3.5-5.0	Sand		A-2-4	13						
		3SS	"	"	"	6.0-7.5	"		"	5						
		4SS	"	"	"	8.5-10.0	"		"	5						
		5SS	"	"	"	13.5-15.0	Gravelly sand		A-1-b(0)	26						
		6SS	"	"	"	18.5-20.0	"		"	24	28	58	14	→	-	-

Appendix A6: Continued.

Boring No.	Project	Sample No.	Station No.	Offset Ft.	Ground Elevation Ft.	Sample Depth Ft.	Soil		Description	Blow per Ft.	Grain Size			Distribution		LL	PL	PI
							Texture				Gravel	Sand	Silt	Clay				
86		SS1	35+00	12LT	1186.0	1.0-2.5	Loam		A-4	19								
		SS2	"	"	"	3.5-5.0	"		"	33								
		SS3	"	"	"	6.0-7.5	"		"	28								
87		SS1	39+25	13LT	1175.0	1.0-2.5	Clay		A-7-5(59)	5								
		SS2	"	"	"	3.5-5.0	Loam		A-4	8								
		SS3	"	"	"	6.0-7.5	"		"	9								
		SS4	"	"	"	8.5-10.0	Clay loam		A-4	10								
		SS5	"	"	"	13.5-15.0	"		"	21								
		SS6	"	"	"	18.5-20.0	"		"	32								
88		BS1	"	"	"	2.0-4.0	Clay		A-7-5(59)	-	-	1.5	47.7	50.8		82	33	49
		SS1	39+25	10RT	1175.4	1.0-2.5	Silty loam		-	3								
		SS2	"	"	"	3.5-5.0	Clay		A-7-5	7								
		SS3	"	"	"	6.0-7.5	Clay loam		A-4	9								
		SS4	"	"	"	8.5-10.0	"		"	17								
		SS5	"	"	"	13.5-15.0	"		"	22								
		SS6	"	"	"	18.5-20.0	"		"	24								

Appendix A7: Borehole Data for S.R. 1 over Elkhorn Creek, 2.8 Miles South of S.R. 28.

[illegible]

Appendix A7: Continued.

Boring No.	Project	Sample No.	Station No.	Offset Ft.	Ground Elevation Ft.	Sample Depth Ft.	Soil Description		Blow per Ft.	Grain Size			Distribution		PL	PI
							Texture	AASHTO		Gravel	Sand	Silt	Clay			
97		1SS	50+31	35LT	957.74	0.0-1.5	Silty loam	A-4	7							
		2SS (Bag)	"	"	"	2.0-4.0	Clay	A-7-6(16)	5	1.6	19.6	46.3	32.5	42.5	22.2	20.3
		3SS	"	"	"	5.0-6.5	"	"	3							
		4SS	"	"	"	7.5-9.0	"	"	5							
		5SS	"	"	"	10.0-11.5	Sand	A-2-4	10							
		6SS	"	"	"	15.0-16.5	Clay	A-7-6	16							
		7SS	"	"	"	20.0-21.5	Silt	A-4	27							
		8SS	"	"	"	25.0-26.5	"	"	28							
		9SS	"	"	"	30.0-31.5	Clay loam	"	27							
		10SS	"	"	"	35.0-36.5	Sandy loam	"	27							
97b		PT1	50+31	32LT	957.74	3.0-5.0	Clay	A-7-6(16)	-							
		PT2	"	"	"	5.0-7.0	"	"	-							
		PT3	"	"	"	7.0-9.0	"	"	-							
		PT1	50+31	29LT	957.74	3.0-5.0	Clay	A-7-6(16)	-							
97c		PT2	"	"	"	5.0-7.0	"	"	-							
		PT3	"	"	"	7.0-9.0	"	"	-							

Appendix A8: Continued.

Boring No.	Project	Sample No.	Station No.	Ottset Fl.	Ground Elevation Fl.	Sample Depth Fl.	Soil		Description	Blow per Fl.	Grain Size			LL	PL	PI
							Texture				Gravel	Sand	Silt			
103		1	41+05	45LT	984.5	1.0-3.5	Sandy loam w/gravel		-	11						
		2	"	"	"	3.5-6.0	Sand & gravel		-	20						
		3	"	"	"	6.0-8.5	"		-	19						
		4	"	"	"	8.5-13.5	"		-	18						
		5	"	"	"	13.5-18.5	"		-	53						
		6	"	"	"	18.5-23.5	Clay & gravel		-	>100						
		7	"	"	"	23.5-28.5	"		-	56						
		8	"	"	"	28.5-30.0	"		-	48						
104		1	41+35	30RT	987.0	1.0-3.5	Sandy clay loam w/trace gravel		-	15						
		2	"	"	"	3.5-6.0	"		-	23						
		3	"	"	"	6.0-8.5	Sand w/trace gravel		-	22						
		4	"	"	"	8.5-13.5	"		-	47						
		5	"	"	"	13.5-18.5	Sand w/gravel & boulders		-	49						
		6	"	"	"	18.5-23.5	Clay w/trace gravel		-	31						
		7	"	"	"	23.5-28.5	"		-	33						
		8	"	"	"	28.5-30.0	Sand w/trace gravel		-	34						

Appendix A10: Continued.

Boring No.	Project	Sample No.	Station No.	Offset Ft.	Ground Elevation Ft.	Sample Depth Ft.	Soil		Description AASHTO	Blow per Ft.	Grain Size				LL	PL	PI
							Texture				Gravel	Sand	Silt	Clay			
109.		1	502+18	30RT	1065.0	1.0-3.5	Sandy clay loam w/grav.		-	8							
		2	"	"	"	3.5-6.0	Clay w/trace gravel		-	9							
		3	"	"	"	6.0-8.5	"		-	13							
		4	"	"	"	8.5-13.5	Sand w/trace gravel		-	12							
		5	"	"	"	13.5-18.5	Sandy clay loam w/trace gravel hardpan		-	9							
110		6	"	"	"	18.5-23.5	"		-	22							
		7	"	"	"	23.5-28.5	"		-	37							
		8	"	"	"	28.5-30.0	"		-	83							
		1	502+45	35LT	1069.0	1.0-3.5	Sandy clay loam w/grav.		-	16							
		2	"	"	"	3.5-6.0	"		-	15							
		3	"	"	"	6.0-8.5	Sandy clay loam w/grav. hardpan		-	28							
		4	"	"	"	8.5-13.5	"		-	18							
		5	"	"	"	13.5-18.5	"		-	45							
		6	"	"	"	18.5-23.5	"		-	24							
		7	"	"	"	23.5-28.5	"		-	20							

Appendix All: Borehole Data for C.R. 400 E Over White River.

Boring No.	Project	Sample No.	Station No.	Offset Ft.	Ground Elevation Ft.	Sample Depth Ft.	Soil		Description	Blow per Ft.	Grain Size				LL	PL	PI
							Texture				Gravel	Sand	Silt	Clay			
111		1SS	21+03	23RT	1092.0	1.0-2.5	Silty clay loam		A-7-6(20)	7	-	14	58	28	44	22	22
		2SS	"	"	"	3.5-5.0	"		"	6							
		3SS	"	"	"	6.0-7.5	"		A-6	24							
		4SS	"	"	"	8.5-1.0	Clay loam		A-6(7)	27	-	24	50	26	27	15	12
		5SS	"	"	"	13.5-15.0	"		"	25							
		6SS	"	"	"	18.5-20.0	"		"	31							
		7SS	"	"	"	23.5-25.0	"		"	69							
		8SS	"	"	"	28.5-30.0	"		"	59							
112		1SS	21+28	14LT	1092.1	1.0-2.5	Clay loam		A-7-6	13							
		2SS	"	"	"	3.5-5.0	"		"	9							
		3SS	"	"	"	6.0-7.5	Silty loam		A-4	28							
		4SS	"	"	"	8.5-10.0	Clay loam		A-6	24							
		5SS	"	"	"	13.5-15.0	"		"	28							
		6SS	"	"	"	18.5-19.2	"		"	>100							
		7SS	"	"	"	23.5-25.0	"		"	>100							
		8SS	"	"	"	28.5-30.0	"		"	84							
		9SS	"	"	"	33.5-35.0	"		"	>100							

Appendix All: Continued.

Boring No.	Project	Sample No.	Station No.	Offset Ft.	Ground Elevation Ft.	Sample Depth Ft.	Soil		Description	Blow per Ft.	Grain Size			LL	PL	PI
							Texture	AASHTO			Gravel	Sand	Silt	Clay		
112		10SS	21+28	14LT	1092.1	38.5-40.0	Sand	-	-	52						
		11SS	"	"	"	43.5-44.5	Sandy loam	-	-	>100						
		12SS	"	"	"	48.5-50.0	Silt	-	-	31						
113		1SS	21+78	4RT	1097.5	8.0-9.5	Silty loam	A-4	-	7						
		2SS	"	"	"	10.5-12.0	Clay loam	A-6	-	24						
		3SS	"	"	"	13.0-14.5	"	"	-	22						
		4SS	"	"	"	15.5-17.0	"	"	-	22						
		5SS	"	"	"	21.5-23.0	"	"	-	30						
		6SS	"	"	"	25.5-27.0	"	"	-	19						
		7SS	"	"	"	30.5-32.0	"	"	-	26						
		8SS	"	"	"	35.5-37.0	"	"	-	25						
114		1SS	22+15	1LT	1097.0	1.0-2.5	Fill	-	-	11						
		2SS	"	"	"	3.5-5.0	"	-	-	18						
		3SS	"	"	"	6.0-7.5	Silty loam	A-4(4)	-	7	-	32	53	15	26	17
		4SS	"	"	"	8.5-10.0	Silty clay loam	A-7-6	-	15						9
		5SS	"	"	"	13.5-15.0	Clay loam w/ gravel	A-6	-	27						
		6SS	"	"	"	18.5-20.0	"	"	-	29						

Appendix A12: Borehole Data for C.R. 300 E Over White River.

Boring No.	Project	Sample No.	Station No.	Offset Ft.	Ground Elevation Ft.	Sample Depth Ft.	Soil		Blow per Ft.	Grain Size			LL	PL	PI
							Texture	Description		Gravel	Sand	Silt			
116		1SS	21+98	CL	1092.3	1.0-2.5	Sandy loam	A-4(0)	19						
		2SS	"	"	"	4.5-6.0	"	"	28	-	52	32	22	19	3
		3SS	"	"	"	7.0-8.5	Silty clay loam	A-6(9)	14	-	20	52	37	25	12
		4SS	"	"	"	9.5-11.0	"	"	21						
		5SS	"	"	"	14.5-16.0	Clay loam	A-4(1)	27	-	32	44	25	20	5
		6SS	"	"	"	19.5-21.0	"	"	30						
		7SS	"	"	"	24.5-26.0	"	"	37						
		8SS	"	"	"	28.5-30.0	"	"	41						
117		1SS	22+92	CL	1092.3	4.5-6.0	Silty clay loam	A-6	16						
		2SS	"	"	"	9.5-11.0	"	"	18						
		3SS	"	"	"	14.5-16.0	Clay loam	A-4	30						
		4SS	"	"	"	19.5-20.0	"	"	>100						
		5SS	"	"	"	24.5-25.0	"	"	>100						
		6SS	"	"	"	29.5-30.0	"	"	>100						
		7SS	"	"	"	34.5-35.0	"	"	>100						
		8SS	"	"	"	39.5-40.9	"	"	>100						

Appendix A15: Borehole Data for C.R. 375 W Over White River.

Boring No.	Project	Sample No.	Station No.	Offset Ft.	Ground Elevation Ft.	Sample Depth Ft.	Soil		Description	Blow per Ft.	Grain Size			Distri bution		LL	PL	PI
							Texture				Gravel	Sand	Silt	Clay				
124		1SS	24+00	7RT	1045.0	1.0-2.5	Sandy loam		A-4	7								
		2SS	"	"	"	3.5-5.0	"		"	8								
		3SS	"	"	"	6.0-7.5	"		"	12								
		4SS	"	"	"	8.5-10.0	"		"	13								
		5SS	"	"	"	13.5-15.0	"		"	20								
		6SS	"	"	"	18.5-20.0	Sand		A-2-4	15								
		7SS	"	"	"	23.5-25.0	Gravelly sand		A-1-b	45								
		8SS	"	"	"	28.5-30.0	Sandy loam		A-4	23								
125		1SS	24+60	7LT	1045.8	1.0-2.5	loam		A-4	9								
		2SS	"	"	"	3.5-5.0	"		"	13								
		3SS	"	"	"	6.0-7.5	"		"	14								
		4SS	"	"	"	8.5-10.0	"		"	13								
		5SS	"	"	"	13.5-15.0	"		"	16								
		6SS	"	"	"	18.5-20.0	Gravelly sand		A-1-b	34								
		7SS	"	"	"	23.5-25.0	"		A-1-b(0)	44								
		8SS	"	"	"	28.5-30.0	"		"	43	32	60	← 8	→	-	-	-	

Appendix A17: Continued.

Boring No.	Project	Sample No.	Station No.	Offset Ft.	Ground Elevation Ft.	Sample Depth Ft.	Soil Description		Blow per Ft.	Grain Size			LL	PL	PI	
							Texture	AASHTO		Gravel	Sand	Silt				Clay
135		1SS	25+20	22LT	1037.0	1.0-2.5	Silty clay loam	A-4	11							
		2SS	"	"	"	3.5-5.0	"	"	7							
		3SS	"	"	"	6.0-7.5	"	"	15							
		4SS	"	"	"	8.5-10.0	Sandy grav.	A-1-a	24							
		5SS	"	"	"	13.5-15.0	Clay	A-6(7)	27	-	17	47	36	27	16	11
		6SS	"	"	"	18.5-20.0	Sand	A-1-b	38							
		7SS	"	"	"	23.5-25.0	Clay	A-6	25							
		8SS	"	"	"	28.5-30.0	"	"	18							
136																
		1SS	21+00	20RT	1033.8	1.0-2.5	Silty loam	-	5							
		2SS	"	"	"	3.5-5.0	Sandy loam	-	7							
		3SS	"	"	"	6.0-7.5	Sandy grav.	A-1-a	18							
137																
		1SS	27+50	22LT	1033.0	1.0-2.5	Silty clay loam	A-4(2)	9	-	14	65	21	27	24	3
		2SS	"	"	"	3.5-5.0	"	"	13							
		3SS	"	"	"	6.0-7.5	Clay w/sand	A-6	13							

Appendix A18: Continued.

[illegible]

Appendix A18: Continued.

Boring No.	Project	Sample No.	Station No.	Offset Fl.	Ground Elevation Ft.	Sample Depth Ft.	Soil Description		Blow per Ft.	Grain Size			Distribution		LL	PL	PI
							Texture	AASHTO		Gravel	Sand	Silt	Clay				
140.		1SS	24+30	8LT	1104.8	1.0-2.5	Sandy loam	A-4(1)	7	-	50	37	13		22	15	7
		2SS	"	"	"	3.5-5.0	Clay loam	A-4	8								
		3SS	"	"	"	6.0-7.5	"	"	9								
		4SS	"	"	"	8.5-10.0	Silty clay	A-7-5	7								
		5SS	"	"	"	13.5-15.0	Sandy loam	A-4	14								
		6SS	"	"	"	18.5-20.0	Sandy grav.	A-1-a(0)	24	59	32	←-9	→		-	-	-
		7SS	"	"	"	23.5-25.0	Sand	A-1-b(0)	22								
		8SS	"	"	"	28.5-30.0	"	"	26	4	89	←-7	→		-	-	-
141		1SS	19+38	24RT	1116.7	1.0-2.5	Clay loam (fill)	A-4	7								
		2SS	"	"	"	3.5-5.0	"	"	17								
		3SS	"	"	"	6.0-7.5	Silty clay loam	A-7-5(16)	2	-	10	61	29	49	36	13	
		4SS	"	"	"	8.5-10.0	Sandy grav.	A-1-a	12								
142		1SS	26+00	15LT	1102.3	1.0-2.5	Clay loam	A-4	13								
		2SS	"	"	"	3.5-5.0	"	"	9								
		3SS	"	"	"	6.0-7.5	"	"	8								
		4SS	"	"	"	8.5-10.0	"	"	6								

Appendix A19: Borehole Data for S. R. 1 Over the White River

Boring No.	Project	Sample No.	Station No.	Offset Ft.	Ground Elevation Ft.	Sample Depth Ft.	Soil Description		Blow per Ft.	Grain Size			LL	PL	PI
							Texture	AASHTO		Gravel	Sand	Silt			
143		1	22+79	17 RT	1017.3	1.0-2.5	Loam w/ trace gravel	A-4	12						
		2	"	"	"	3.5-5.0	clay loam w/ trace gravel	A-6	14						
		3	"	"	"	6.0-7.5	sand with little gravel	A-1-b	12						
		4	"	"	"	8.5-10	"	"	61						
		5	"	"	"	13.5-15.0	clay loam w/ trace gravel	A-6	82						
		6	"	"	"	18.5-19.0	sand w/ little gravel	A-1-b	> 200						
		7	"	"	"	23.5-25.5	"	"	> 200						
		8	"	"	"	28.5-30	clay loam w/ trace gravel	A-6	> 200						
		9RC	"	"	"	32 - 37	Dolomite	-	-						
144		1	24+15	25LT	1005.7	1.0-2.5	Silty clay	A-6	9						
		2	"	"	"	3.5-5.0	Sandy loam	A-4	48						
		3	"	"	"	6.0-7.5	sand w/ little gravel	A-1-b	15						
		4	"	"	"	8.5-10.0	clay loam w/ trace gravel	A-6	50						
		5	"	"	"	13.5-15	clay loam w/ gravel & boulders	A-6	62						
		6	"	"	"	18.2-19.6	Dolomite	-	> 100						
		7RC	"	"	"	19.6-23.7	"	-	-						

APPENDIX A19: Page 2

Boring No.	Project	Sample No.	Station No.	Oiltset Fl.	Ground Elevation Ft.	Sample Depth Ft.	Soil Description		Blow per Ft.	Grain Size			LL	PL	PI	
							Texture	AASHTO		Gravel	Sand	Silt				Clay
145		1	24+70	33 RT	1006.8	1.1-2.6	Clay loam w/ trace gravel	A-6	6							
		2	"	"	"	3.5-5.0	w/ sand streaks	"	6							
		3	"	"	"	6.0-7.5	"	"	11							
		4	"	"	"	8.5-10.0	Sand w/ gravel & cobbles & boulders	A-1-b	19							
		5	"	"	"	13.2-14.3	"	"	>100							
		6	"	"	"	18.2-20.0	"	"	>100							
146		7RC	"	"	"	20.5-25.0	Dolomite silty clay loam	-	-							
		1	24+70	38 RT	1006.8	0.0-1.5	"	-	7							
		2	"	"	"	1.5-3.0	Sandy Loam	A-4	6							
		3	"	"	"	3.0-4.5	"	"	5							
		4	"	"	"	4.5-6.0	Sand w/ little gravel	A-1-b	7							
147		5	"	"	"	6.0-7.5	"	"	26							
		1PT	24+68	39 RT	1006.8	2.0-4.0	Sandy Loam									
	148		1PT	24+74	39 RT	1006.8	Sandy Loam									
149		1PT	24+66	39 RT		3.0-4.5	Clay Loam	A-6(6)		0	36.5	36.9	8.3	32	19	14

APPENDIX A19: Page 3

Boring No.	Project	Sample No.	Station No.	Offset Ft.	Ground Elevation Ft.	Sample Depth Ft.	Soil Description		Blow per Ft.	Grain Size				LL	PL	PI
							Texture	AASHTO		Gravel	Sand	Silt	Clay			
150		1	26+00	38 RT	1008.6	1.0-2.5	Clay loam	A-6	11							
		2	"	"	"	3.5-5.0	"	"	8							
		3	"	"	"	6.0-7.5	Sandy loam	A-4	6							
		4	"	"	"	8.0-8.5	Sand w/ little gravel, cobbles & boulders	A-1-b	100							
		5	"	"	"	8.7-9.7	"	"	100							
		6	"	"	"	10.0-11.5	"	"	28							
151		1	26+03.11	RT	1013.8	0.0-1.5	Crushed Stone	-	20							
		2	"	"	"	1.5-3.0	Loam w/ trace gravel	A-4	2							
		3	"	"	"	3.0-4.5	"	"	5							
		4	"	"	"	4.5-6.0	"	"	6							
		5	"	"	"	6.0-7.5	Clay loam	A-6	9							
		6	"	"	"	7.5-9.0	"	"	9							
		7	"	"	"	9.0-10.5	"	"	6							
		8	"	"	"	10.5-12.0	"	"	4							
		9	"	"	"	12.0-13.5	Sandy loam w/ trace gravel	A-4	7							
		10	"	"	"	13.5-15.0	Sand w/ little gravel w/ cobbles	A-1-b	29							

APPENDIX A19: Page 4

[illegible]

APPENDIX B

PHYSICAL AND CHEMICAL PROPERTIES OF
AGRICULTURAL SOILS IN RANDOLPH COUNTY (2)

APPENDIX B. PHYSICAL AND CHEMICAL PROPERTIES OF AGRICULTURAL SOILS IN RANDOLPH COUNTY (2)

Soil name and map symbol	Depth		Clay Pct	Moist bulk density g/cc	Permeability in/hr	Available water capacity		Soil reaction pH	Shrink-swell potential	Erosion factors		Wind erodi- bility group	Organic matter Pct
	In	Pct				In/in				K	T		
An----- Allison Variant	0-18	40-45	1.35-1.55	0.2-0.6	0.18-0.21	6.6-7.3	Moderate	0.28	5	7	4-6		
	18-42	35-45	1.35-1.65	0.2-0.6	0.16-0.19	6.6-7.3	Moderate	0.28					
	42-60	30-40	1.40-1.65	0.2-0.6	0.14-0.18	6.6-7.8	Moderate	0.28					
B1A----- Blount	0-12	22-27	1.35-1.55	0.6-2.0	0.20-0.24	5.1-7.3	Low	0.43	3	6	2-3		
	12-31	35-50	1.40-1.70	0.06-0.2	0.12-0.19	4.5-8.4	Moderate	0.43					
	31-60	27-38	1.60-1.85	0.06-0.2	0.07-0.10	7.4-8.4	Moderate	0.43					
Ca----- Carlisle	0-60	---	0.13-0.23	0.2-6.0	0.35-0.45	4.5-7.3	---	---	---	3	>70		
CeB----- Celina	0-17	14-26	1.30-1.50	0.6-2.0	0.20-0.24	5.6-7.3	Low	0.37	5	6	1-3		
	17-32	35-48	1.45-1.70	0.2-0.6	0.16-0.19	4.5-7.8	Moderate	0.37					
	32-60	16-27	1.60-1.82	0.2-0.6	0.06-0.10	7.4-8.4	Low	0.37					
CxB----- Celina	0-11	14-26	1.30-1.50	0.6-2.0	0.20-0.24	5.6-7.3	Low	0.37	5	6	1-3		
	11-29	35-48	1.45-1.70	0.2-0.6	0.16-0.19	4.5-7.8	Moderate	0.37					
	29-60	16-27	1.60-1.82	0.2-0.6	0.06-0.10	7.4-8.4	Low	0.37					
CnB----- Crosby	0-13	15-24	1.40-1.55	0.6-2.0	0.19-0.22	5.1-7.3	Low	0.37	3	5	1-3		
	13-26	35-40	1.45-1.60	0.06-0.2	0.16-0.17	5.1-7.3	Moderate	0.37					
	26-60	15-27	1.70-2.00	0.06-0.2	0.05-0.15	7.4-8.4	Low	0.37					
Ee----- Eel	0-10	18-27	1.30-1.50	0.6-2.0	0.20-0.24	5.6-7.3	Low	0.37	5	5	1-3		
	10-34	18-27	1.30-1.50	0.6-2.0	0.17-0.22	6.1-7.8	Low	0.37					
	34-60	10-27	1.30-1.50	0.6-2.0	0.19-0.21	6.1-8.4	Low	0.37					
EnA----- Eldean Variant	0-8	21-27	1.30-1.45	0.6-2.0	0.20-0.22	5.6-6.0	Low	0.28	4	6	3-5		
	8-20	35-45	1.45-1.65	0.2-0.6	0.10-0.15	6.1-6.5	Moderate	0.28					
	20-25	12-35	1.45-1.70	2.0-6.0	0.06-0.10	6.6-7.8	Low	0.10					
	25-60	5-12	1.55-1.75	2.0-20	0.02-0.04	7.4-8.4	Low	0.10					
FcA*: Fincastle	0-12	11-22	1.40-1.55	0.6-2.0	0.22-0.24	5.1-7.3	Low	0.37	5	5	1-3		
	12-45	23-35	1.45-1.65	0.6-2.0	0.18-0.20	4.5-7.8	Moderate	0.37					
	45-60	20-26	1.55-1.90	0.2-0.6	0.05-0.19	7.4-8.4	Low	0.37					
Crosby-----	0-11	11-24	1.35-1.45	0.6-2.0	0.20-0.24	5.1-7.3	Low	0.43	3	5	1-3		
	11-22	35-45	1.50-1.70	0.06-0.2	0.15-0.20	5.1-7.8	Moderate	0.43					
	22-60	15-27	1.70-2.00	0.06-0.6	0.05-0.17	7.4-8.4	Low	0.43					
FoA, FoB----- Fox	0-11	10-17	1.35-1.55	0.6-2.0	0.17-0.24	5.1-7.3	Low	0.37	4	5	1-3		
	11-27	18-35	1.55-1.65	0.6-2.0	0.10-0.22	5.1-7.3	Moderate	0.43					
	27-35	18-35	1.55-1.65	0.6-2.0	0.10-0.19	5.1-8.4	Moderate	0.32					
	35-60	0-2	1.30-1.80	6.0-20	0.02-0.7	7.4-8.4	Low	0.10					
FxC3----- Fox	0-7	27-35	1.55-1.65	0.6-2.0	0.14-0.23	5.1-7.3	Moderate	0.32	3	6	.5-2		
	7-20	18-35	1.55-1.65	0.6-2.0	0.10-0.22	5.1-7.3	Moderate	0.43					
	20-31	18-35	1.55-1.65	0.6-2.0	0.10-0.19	5.1-8.4	Moderate	0.32					
	31-60	0-2	1.30-1.80	>6.0	0.02-0.7	7.4-8.4	Low	0.10					
GnB2----- Glynwood	0-8	16-27	1.25-1.50	0.6-2.0	0.20-0.24	5.6-7.3	Low	0.43	3	6	1-3		
	8-26	35-55	1.45-1.75	0.06-0.2	0.11-0.18	4.5-7.8	Moderate	0.32					
	26-60	27-36	1.65-1.85	0.06-0.2	0.06-0.10	7.4-8.4	Moderate	0.32					

APPENDIX B (CONTINUED)

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodi- bility group	Organic matter
								K	T		
	In	Pct	g/cc	In/hr	In/in	pH					Pct
LnB2, LnE----- Losantville	0-10	18-27	1.30-1.55	0.6-2.0	0.20-0.24	5.6-7.3	Low-----	0.37	3	6	1-3
	10-23	35-45	1.40-1.70	0.2-0.6	0.09-0.19	6.1-7.8	Moderate-----	0.37			
	23-60	12-24	1.50-1.80	0.06-0.2	0.05-0.19	7.4-8.4	Low-----	0.37			
LoC3, LoD3----- Losantville	0-8	27-35	1.30-1.60	0.2-0.6	0.17-0.19	5.6-7.3	Moderate-----	0.37	2	6	.5-2
	8-22	35-45	1.40-1.70	0.2-0.6	0.09-0.19	6.1-7.8	Moderate-----	0.37			
	22-60	12-24	1.50-1.80	0.06-0.2	0.05-0.19	7.4-8.4	Low-----	0.37			
LsB2----- Losantville	0-6	18-27	1.30-1.55	0.6-2.0	0.20-0.24	5.6-7.3	Low-----	0.37	3	6	1-3
	6-18	35-45	1.40-1.70	0.2-0.6	0.09-0.19	6.1-7.8	Moderate-----	0.37			
	18-60	12-24	1.50-1.80	0.06-0.2	0.05-0.19	7.4-8.4	Low-----	0.37			
LtC3, LtD3----- Losantville	0-4	27-35	1.30-1.60	0.2-0.6	0.17-0.19	5.6-7.3	Moderate-----	0.37	2	6	.5-2
	4-11	35-45	1.40-1.70	0.2-0.6	0.09-0.19	6.1-7.8	Moderate-----	0.37			
	11-60	12-24	1.50-1.80	0.06-0.2	0.05-0.19	7.4-8.4	Low-----	0.37			
Lv----- Linwood	0-18	0	0.15-0.40	0.2-6.0	0.35-0.45	4.5-7.8	-----	-----	2	2	42-65
	18-60	0-35	1.80-1.95	0.6-2.0	0.16-0.20	5.6-8.4	Low-----	-----			
MoA, MoB2----- Miami	0-10	18-25	1.30-1.45	0.6-2.0	0.22-0.24	6.1-7.3	Low-----	0.37	5	6	1-3
	10-32	22-35	1.35-1.45	0.6-2.0	0.18-0.21	5.6-7.3	Moderate-----	0.37			
	32-65	18-27	1.40-1.60	0.6-2.0	0.16-0.20	7.4-8.4	Low-----	0.37			
	65-80	0-27	1.65-1.80	0.6-2.0	0.01-0.12	7.4-8.4	Low-----	0.10			
MuB----- Morley	0-8	22-27	1.35-1.55	0.6-2.0	0.20-0.24	5.1-7.3	Low-----	0.43	3	6	1-3
	8-11	27-40	1.45-1.65	0.2-0.6	0.18-0.20	5.1-7.3	Moderate-----	0.43			
	11-24	35-50	1.55-1.70	0.2-0.6	0.11-0.15	6.1-7.8	Moderate-----	0.43			
	24-32	27-50	1.60-1.80	0.06-0.6	0.07-0.12	6.1-8.4	Moderate-----	0.43			
	32-60	27-40	1.60-1.80	0.06-0.6	0.07-0.12	6.1-8.4	Moderate-----	0.43			
MyC3----- Morley	0-8	27-35	1.40-1.60	0.2-0.6	0.18-0.22	5.1-6.5	Moderate-----	0.43	2	7	.5-3
	8-27	35-50	1.55-1.70	0.2-0.6	0.11-0.15	6.1-7.8	Moderate-----	0.43			
	27-60	27-40	1.60-1.70	0.06-0.6	0.07-0.12	6.1-8.4	Moderate-----	0.43			
Pn----- Patton	0-11	27-35	1.15-1.35	0.6-2.0	0.21-0.23	5.6-7.3	Moderate-----	0.28	5	7	3-5
	11-32	27-35	1.25-1.45	0.6-2.0	0.18-0.20	6.1-7.8	Moderate-----	0.28			
	32-80	15-35	1.30-1.50	0.2-0.6	0.18-0.22	7.4-9.0	Moderate-----	0.28			
Pw----- Pewamo	0-18	27-40	1.35-1.55	0.6-2.0	0.17-0.22	6.1-7.3	Moderate-----	0.28	5	6	3-10
	18-46	35-50	1.40-1.70	0.2-0.6	0.12-0.20	5.6-7.8	Moderate-----	0.28			
	46-65	30-40	1.50-1.75	0.2-0.6	0.14-0.18	7.4-8.4	Moderate-----	0.28			
Px----- Pewamo	0-18	18-27	1.35-1.55	0.6-2.0	0.20-0.22	6.1-7.3	Low-----	0.28	5	5	3-5
	18-50	35-50	1.40-1.70	0.2-0.6	0.12-0.20	5.6-7.8	Moderate-----	0.28			
	50-60	30-40	1.50-1.75	0.2-0.6	0.14-0.18	7.4-8.4	Moderate-----	0.28			
Sa----- Saranac	0-8	40-60	1.30-1.50	0.06-0.2	0.12-0.20	6.1-7.8	Moderate-----	0.28	5	4	4-6
	8-40	35-60	1.40-1.70	0.2-0.6	0.10-0.20	6.1-7.8	Moderate-----	0.28			
	40-60	35-60	1.50-1.75	0.2-0.6	0.10-0.20	6.6-8.4	Moderate-----	0.28			
Sa----- Sleeth	0-12	11-22	1.30-1.45	0.6-2.0	0.20-0.24	6.6-7.3	Low-----	0.32	5	5	.5-3
	12-50	20-35	1.45-1.60	0.6-2.0	0.15-0.19	5.6-7.8	Moderate-----	0.32			
	50-65	2-5	1.60-1.80	>20	0.02-0.04	7.9-8.4	Low-----	0.10			
So----- Sloan	0-8	15-27	1.20-1.40	0.6-2.0	0.20-0.24	6.1-7.8	Low-----	0.37	5	6	3-6
	8-32	22-35	1.25-1.55	0.2-2.0	0.15-0.19	6.1-8.4	Moderate-----	0.37			
	32-80	10-30	1.20-1.50	0.2-2.0	0.13-0.18	6.6-8.4	Low-----	0.37			

APPENDIX B (CONTINUED)

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodi- bility group	Organic matter
								K	T		
	In	Pct	g/cc	In/hr	In/in	pH					Pct
Tr----- Treaty	0-7	18-27	1.50-1.70	0.6-2.0	0.23-0.25	5.6-7.3	Low-----	0.32	5	6	4-6
	7-32	28-35	1.50-1.70	0.6-2.0	0.18-0.20	6.1-7.8	Moderate-----	0.43			
	32-45	20-35	1.50-1.70	0.6-2.0	0.15-0.19	6.6-8.4	Moderate-----	0.43			
	45-60	15-27	1.70-1.90	0.2-0.6	0.17-0.19	7.4-8.4	Low-----	0.43			
Ts----- Treaty	0-17	18-27	1.50-1.70	0.6-2.0	0.23-0.25	5.6-7.3	Low-----	0.32	5	6	4-6
	17-25	28-35	1.50-1.70	0.6-2.0	0.18-0.20	6.1-7.8	Moderate-----	0.43			
	25-47	20-35	1.50-1.70	0.6-2.0	0.15-0.19	6.6-7.8	Moderate-----	0.43			
	47-60	15-27	1.70-1.90	0.2-0.6	0.17-0.19	7.4-8.4	Low-----	0.43			
Ud*. Udorthents											
Wa----- Wallkill	0-5	10-27	1.15-1.40	0.6-2.0	0.16-0.21	5.1-7.8	Low-----	0.37	5	---	3-8
	5-34	15-35	1.15-1.40	0.6-2.0	0.15-0.20	5.1-7.8	Low-----	0.32			
	34-65	---	0.25-0.45	2.0-20	0.35-0.45	5.6-7.8	-----	---			
Wo----- Westland	0-14	27-35	1.35-1.50	0.6-2.0	0.18-0.21	5.6-7.3	Moderate-----	0.28	5	6	3-6
	14-27	27-35	1.45-1.60	0.6-2.0	0.12-0.19	5.6-7.3	Moderate-----	0.28			
	27-38	18-27	1.40-1.60	0.6-2.0	0.05-0.13	7.4-8.4	Low-----	0.20			
	38-45	18-27	1.40-1.60	0.6-2.0	0.05-0.13	7.4-8.4	Low-----	0.20			
	45	---	---	---	---	---	-----	---			

APPENDIX C

ENGINEERING INDEX PROPERTIES OF AGRICULTURAL SOILS IN RANDOLPH COUNTY (2)

APPENDIX C. ENGINEERING INDEX PROPERTIES OF AGRICULTURAL SOILS IN RANDOLPH COUNTY (2)

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches Pct	Percentage passing sieve number--				Liquid limit Pct	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
An----- Allison Variant	0-18	Silty clay-----	CL	A-7	0	100	100	95-100	90-95	40-50	15-25
	18-42	Silty clay, silty clay loam.	CL	A-6, A-7	0	100	100	95-100	85-95	35-50	15-25
	42-60	Clay loam-----	CL	A-6, A-7	0	100	100	90-100	70-80	35-45	10-20
BlA----- Blount	0-12	Silt loam-----	CL	A-6, A-4	0-5	95-100	95-100	90-100	80-95	25-40	8-20
	12-31	Silty clay loam, silty clay, clay loam.	CH, CL	A-7, A-6	0-5	95-100	90-100	80-90	75-85	35-60	15-35
	31-60	Silty clay loam, clay loam.	CL	A-6, A-7	0-10	90-100	90-100	80-100	70-90	30-45	10-25
Ca----- Carlisle	0-60	Sapric material	PT	A-8	---	---	---	---	---	---	---
Ce2----- Celina	0-17	Silt loam-----	ML	A-4	0	100	90-100	90-100	70-85	26-40	3-10
	17-32	Clay, silty clay, silty clay loam.	CL	A-6, A-7	0	100	90-100	80-95	70-85	32-48	12-28
	32-60	Loam, silt loam	CL, CL-ML	A-4, A-6	0	75-95	75-90	65-90	50-80	20-36	4-16
CxB----- Celina	0-11	Silt loam-----	ML	A-4	0	100	90-100	90-100	70-85	26-40	3-10
	11-29	Clay, clay loam, silty clay loam.	CL	A-6, A-7	0-10	75-95	75-90	65-90	50-80	32-48	12-28
	29-60	Loam, silt loam	CL, CL-ML	A-4, A-6	0-10	75-95	75-90	65-90	50-80	20-36	4-16
CnB----- Crosby	0-13	Silt loam-----	CL-ML, CL	A-4, A-6	0	100	95-100	85-100	65-90	20-35	5-15
	13-26	Silty clay loam, clay loam.	CL	A-6, A-7	0-10	85-95	80-90	65-90	50-70	35-45	15-20
	26-60	Loam-----	CL-ML, CL	A-4, A-6	0-10	85-95	80-90	65-90	50-70	20-35	5-15
Ee----- Eel	0-10	Silt loam-----	ML, CL, CL-ML	A-4, A-6	0	100	100	90-100	75-85	24-40	3-15
	10-34	Silt loam, loam	ML, CL, CL-ML	A-4, A-6	0	100	100	90-100	75-85	24-40	3-15
	34-60	Stratified sandy loam to silty clay loam.	ML, CL, CL-ML	A-4, A-6	0	100	90-100	70-80	55-70	24-40	3-15
EnA----- Eldean Variant	0-8	Loam-----	CL	A-6, A-4	0	95-100	95-100	85-95	60-75	25-35	8-15
	8-20	Gravelly clay, clay loam.	CL	A-7, A-6	0	75-100	75-80	65-75	50-60	35-50	15-25
	20-25	Very gravelly coarse sandy loam.	SM-SC, GM-GC, GC, SC	A-2, A-1	0-5	40-75	35-60	20-45	12-25	20-40	4-15
	25-60	Very gravelly loamy coarse sand, gravelly sand.	SP, SP-SM, GP, GP-GM	A-1	0-5	25-55	20-50	10-30	3-12	<25	NP-4
FCA*: Pincastle-----	0-12	Silt loam-----	CL, ML, CL-ML	A-4	0	100	95-100	90-100	75-93	<25	3-10
	12-45	Silty clay loam, silt loam.	CL	A-6	0	100	100	95-100	85-95	30-40	10-15
	45-60	Loam-----	CL	A-4, A-6	0-3	88-96	87-90	70-86	50-66	25-30	8-11

APPENDIX C (CONTINUED)

Soil name and map symbol	Depth In	USDA texture	Classification		Frag- ments > 3 inches Pct	Percentage passing sieve number--				Liquid limit Pct	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
FcA*: Crosby-----	0-11	Silt loam-----	CL, CL-ML, ML	A-4, A-6	0	100	95-100	80-100	50-90	15-30	4-15
	11-22	Clay loam, silty clay loam, clay.	CL	A-6, A-7	0-3	90-100	85-100	75-95	65-95	35-50	15-25
	22-60	Loam-----	CL, ML, CL-ML	A-4, A-6	0-3	85-100	80-95	75-90	50-65	15-30	4-15
FoA, FoB----- Fox	0-11	Loam-----	ML, CL, SM, SC	A-4	0	70-100	65-100	60-95	45-90	<25	3-8
	11-27	Silty clay loam, silt loam, clay loam.	CL, SC, GC	A-2, A-6, A-7	0	65-100	55-100	40-100	30-95	22-50	10-25
	27-35	Clay loam, loam, sandy clay loam.	CL, SC, GC	A-2, A-6, A-7	0-5	65-100	55-100	30-100	15-80	22-45	10-25
	35-60	Sand and gravel, sand, coarse sand.	SP, GP, SP-SM, GP-GM	A-1, A-2, A-3	0-10	30-100	30-100	10-95	2-10	---	NP
PxC3----- Fox	0-7	Clay loam-----	CL, SC	A-2, A-4, A-6	0	70-100	65-100	60-100	25-95	25-40	9-20
	7-20	Sandy clay loam, silt loam, clay loam.	CL, SC, GC	A-2, A-6, A-7	0	65-100	55-100	40-100	30-95	22-50	10-25
	20-31	Clay loam, sandy loam, sandy clay loam.	CL, SC, GC	A-2, A-6, A-7	0-5	65-100	55-100	30-100	15-80	22-45	10-25
	31-60	Sand and gravel, sand, coarse sand.	SP, GP, SP-SM, GP-GM	A-1, A-2, A-3	0-10	30-100	30-100	10-95	2-10	---	NP
GnB2----- Glynwood	0-8	Silt loam-----	CL-ML, CL	A-4, A-6	0	95-100	90-100	80-100	55-90	23-40	4-15
	8-26	Clay, clay loam, silty clay loam.	CL, CH	A-7, A-6	0-5	95-100	85-100	75-100	65-95	35-55	15-30
	26-60	Clay loam, silty clay loam.	CL	A-6, A-4	0-5	95-100	80-100	75-95	65-90	25-40	7-18
LnB2, LnE----- Losantville	0-10	Silt loam-----	CL, CL-ML	A-4, A-6	0-2	95-100	90-100	80-100	65-90	20-30	5-12
	10-23	Clay, clay loam	CL	A-7, A-6	0-2	90-100	85-100	75-95	60-90	35-50	15-25
	23-60	Loam-----	CL, CL-ML	A-4	0-5	85-95	80-95	65-85	50-70	20-30	5-10
LoC3, LoD3----- Losantville	0-8	Clay loam-----	CL	A-6	0-2	95-100	90-100	80-100	65-80	30-40	11-20
	8-22	Clay, clay loam	CL	A-7, A-6	0-2	90-100	85-100	75-95	60-90	35-50	15-25
	22-60	Loam-----	CL, CL-ML	A-4	0-5	85-95	80-95	65-85	50-70	20-30	5-10
LsB2----- Losantville	0-6	Silt loam-----	CL, CL-ML	A-4, A-6	0-2	95-100	90-100	80-100	65-90	20-30	5-12
	6-18	Silty clay loam, clay loam.	CL	A-7, A-6	0-10	85-95	80-90	65-85	50-70	35-50	15-25
	18-60	Loam-----	CL, CL-ML	A-4	0-10	85-95	80-90	65-85	50-70	20-30	5-10
LtC3, LtD3----- Losantville	0-4	Clay loam-----	CL	A-6	0-2	95-100	90-100	80-100	65-80	30-40	11-20
	4-11	Clay, clay loam	CL	A-7, A-6	0-10	85-95	80-90	65-85	50-70	35-50	15-25
	11-60	Loam-----	CL, CL-ML	A-4	0-10	85-95	80-90	65-85	50-70	20-30	5-10

APPENDIX C (CONTINUED)

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches Pct	Percentage passing sieve number--				Liquid limit Pct	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
Lv----- Linwood	0-18	Sapric material	PT	A-8	0	---	---	---	---	---	---
	18-60	Clay loam, sandy loam, silty clay loam.	CL, ML, SM, SC	A-4, A-6	0	100	95-100	60-100	35-95	15-40	NP-20
MoA, MoB2----- Miami	0-10	Silt loam	CL-ML, CL	A-4, A-6	0	100	95-100	85-100	70-90	20-30	6-15
	10-32	Silty clay loam, clay loam, silt loam.	CL	A-6	0	100	90-100	80-100	65-95	30-40	10-20
	32-65	Loam, silt loam	CL-ML, CL	A-4, A-6	0	100	90-100	75-100	55-85	20-35	5-15
	65-80	Stratified gravelly sandy clay loam to very gravelly coarse sand.	GP, GP-GM, SP, SP-SM	A-1, A-4	0-3	40-55	30-60	15-80	2-75	<30	NP-10
MuB----- Morley	0-8	Silt loam	CL, CL-ML	A-6, A-4	0-5	95-100	95-100	90-100	75-95	25-40	5-15
	8-11	Silty clay loam, clay loam.	CL	A-6, A-7	0-10	95-100	90-100	85-95	80-90	30-50	15-30
	11-24	Silty clay, clay loam, clay.	CL, CH	A-7	0-10	95-100	90-100	85-95	80-90	40-60	15-35
	24-32	Silty clay loam, clay loam, silty clay.	CL, CH	A-6, A-7	0-10	95-100	90-100	85-95	80-90	30-60	15-30
	32-60	Silty clay loam, clay loam.	CL	A-6, A-7	0-10	95-100	90-100	85-95	80-90	30-50	15-30
MyC3----- Morley	0-8	Clay loam	CL	A-6, A-7	0-5	95-100	90-100	85-95	80-90	30-45	15-25
	8-27	Silty clay, clay loam, clay.	CL, CH	A-7	0-10	95-100	90-100	85-95	80-90	40-60	15-35
	27-60	Silty clay loam, clay loam.	CL	A-6, A-7	0-10	95-100	90-100	85-95	80-90	30-50	15-30
Pn----- Patton	0-11	Silty clay loam	CL	A-6	0	100	100	95-100	75-95	30-40	15-25
	11-32	Silty clay loam	CL, CH, ML, MH	A-7	0	100	100	95-100	80-100	40-55	15-25
	32-80	Stratified gravelly sandy loam to silty clay loam.	CL, SC	A-6	0	95-100	75-100	85-100	50-95	25-40	10-20
Pw----- Pewamo	0-18	Silty clay loam	CL	A-6, A-7	0-5	90-100	80-100	80-100	70-90	35-50	15-25
	18-46	Clay loam, clay, silty clay.	CL, CH	A-7, A-6	0-5	95-100	90-100	90-100	75-95	35-55	15-30
	46-65	Clay loam, silty clay loam.	CL	A-7	0-5	95-100	90-100	90-100	70-90	40-50	15-25
Px----- Pewamo	0-18	Silt loam	ML, CL, CL-ML	A-4	0-5	90-100	80-100	80-95	60-85	20-35	3-10
	18-50	Clay loam, clay, silty clay.	CL, CH	A-7, A-6	0-5	95-100	90-100	90-100	75-95	35-55	15-30
	50-60	Clay loam, silty clay loam.	CL	A-7	0-5	95-100	90-100	90-100	70-90	40-50	15-25
Sa----- Saranac	0-8	Silty clay	CL, CH	A-7	0	100	100	95-100	80-95	45-65	25-40
	8-40	Silty clay, silty clay loam, clay.	CL, CH	A-7	0	100	95-100	90-100	70-90	40-60	20-35
	40-60	Clay loam, silty clay loam, silty clay.	CL, CH	A-7	0	100	95-100	90-100	70-90	40-60	20-35

APPENDIX C (CONTINUED)

[illegible]

APPENDIX D

STATISTICAL STREAM FLOW DATA FOR SELECTED STREAMS IN RANDOLPH COUNTY (49)

APPENDIX D-1. STATISTICAL STREAM FLOW DATA FOR LITTLE MISSISSINEWA RIVER (49)

03325311 LITTLE MISSISSINEWA RIVER AT UNION CITY, IN

LOCATION.--Lat 40°11'46", long 84°49'45", in SE 1/4 sec. 26, T.18 N., R.1 W., Randolph County, Hydrologic Unit 05120103, on right bank, 85 ft downstream from Westinghouse Road, 0.5 mi downstream from Little ditch, 0.8 mi upstream from City Drain, and 1.2 mi west of the Post Office in Union City.

DRAINAGE AREA.--9.67 mi².

PERIOD OF RECORD.--October 1982 to September 1985.

GAGE.--Water-stage recorder. Datum of gage is 1075.50 ft above National Geodetic Vertical Datum of 1929.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 234 ft³/s Feb. 23, 1985 gage height, 7.22 ft; no flow at times for most years.

DURATION TABLE OF DAILY MEAN DISCHARGES FOR YEAR ENDING SEPTEMBER 30

CLASS YEAR	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
	NUMBER OF DAYS IN CLASS																																		
1983	60	1	24	7	11	6		7	2	5	6	10	5	5	12	30	21	27	22	23	20	15	6	7	9	7	4	3	7	2	1				
1984	32	1	7	2	3	1	5	3	8	6	8	10	6	22	10	22	22	33	21	19	13	20	12	15	11	10	10	14	11	7	2				
1985						1	5	5	10	11	22	14	12	16	10	29	17	34	30	18	25	19	13	11	13	12	7	9	8	5	6			3	

CLASS	VALUE	TOTAL	ACCUM	PERCT	CLASS	VALUE	TOTAL	ACCUM	PERCT	CLASS	VALUE	TOTAL	ACCUM	PERCT
0	0.00	92	1096	100.00	12	0.43	23	803	73.27	24	14.0	33	161	14.69
1	0.01	2	1004	91.61	13	0.58	43	780	71.17	25	19.0	29	128	11.68
2	0.02	31	1002	91.42	14	0.77	32	737	67.24	26	25.0	21	99	9.03
3	0.03	9	971	88.59	15	1.0	81	705	64.32	27	33.0	26	78	7.12
4	0.04	14	962	87.77	16	1.4	60	624	56.93	28	44.0	26	52	4.74
5	0.06	8	948	86.50	17	1.8	94	564	51.46	29	59.0	14	26	2.37
6	0.08	10	940	85.77	18	2.5	73	470	42.88	30	79.0	9	12	1.09
7	0.10	15	930	84.85	19	3.3	60	397	36.22	31	110.0	0	3	0.27
8	0.14	20	915	83.49	20	4.4	58	337	30.75	32	140.0	3	3	0.27
9	0.18	22	895	81.66	21	5.8	54	279	25.46	33				
10	0.24	36	873	79.65	22	7.8	31	225	20.53	34				
11	0.32	34	837	76.37	23	10.0	33	194	17.70					

VALUE EXCEEDED 'P' PERCENT OF TIME

P95 *	0.01
P90 *	0.03
P75 *	0.37
P70 *	0.64
P50 *	1.9
P25 *	6.0
P10 *	22.7

LOWEST MEAN DISCHARGE AND RANKING FOR THE FOLLOWING NUMBER OF CONSECUTIVE DAYS IN YEAR ENDING MARCH 31

YEAR	1	3	7	14	30	60	90	120	183
1984	0.00 1	0.00 1	0.00 1	0.00 1	0.00 1	0.00 1	0.04 1	0.29 1	1.30 1
1985	0.00 2	0.00 2	0.00 2	0.00 2	0.01 2	0.19 2	0.63 2	1.30 2	2.50 2

HIGHEST MEAN DISCHARGE AND RANKING FOR THE FOLLOWING NUMBER OF CONSECUTIVE DAYS IN YEAR ENDING SEPTEMBER 30

YEAR	1	3	7	15	30	60	90	120	183
1983	79.00 3	66.00 3	44.00 3	29.00 3	26.00 3	18.00 3	13.00 3	11.00 3	9.10 3
1984	96.00 2	83.00 2	54.00 2	43.00 2	32.00 2	27.00 2	22.00 1	18.00 2	15.00 2
1985	218.00 1	153.00 1	99.00 1	57.00 1	37.00 1	29.00 1	22.00 2	22.00 1	18.00 1

APPENDIX D-1 (CONTINUED)

ANNUAL VALUES

ANNUAL MEAN DISCHARGE AND RANKING
IN YEAR ENDING MARCH 31

1984	8.20	1
1985	11.00	2

ANNUAL MEAN DISCHARGE AND RANKING
IN YEAR ENDING SEPTEMBER 30

1983	4.80	3
1984	8.70	2
1985	9.90	1

NORMAL MONTHLY MEANS (ALL DAYS)

YEAR	OCT	NOV	DEC	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT
1982	*	*	*	*	*	*	*	*	*	*	*	*
1983	0.04	0.60	7.95	2.51	6.34	3.05	18.60	16.00	1.55	0.71	0.02	0.00
1984	0.85	8.40	14.60	1.71	12.20	23.50	30.40	6.94	2.79	2.46	1.35	0.05
1985	1.42	11.00	20.60	11.90	26.40	21.20	12.80	8.00	3.31	0.67	2.56	0.21

APPENDIX D-2 (CONTINUED)

CLASS	VALUE	TOTAL	ACCUM	PERCT	CLASS	VALUE	TOTAL	ACCUM	PERCT	CLASS	VALUE	TOTAL	ACCUM	PERCT
0	0.00	0	14245	100.00	12	4.5	896	12325	86.52	24	280.0	371	1405	9.86
1	0.10	1	14245	100.00	13	6.3	1050	11429	80.23	25	400.0	305	1034	7.26
2	0.14	0	14244	99.99	14	8.9	1046	10379	72.86	26	560.0	235	729	5.12
3	0.20	7	14244	99.99	15	13.0	939	9333	65.52	27	790.0	171	494	3.47
4	0.28	10	14237	99.94	16	18.0	1120	8394	58.93	28	1100.0	155	323	2.27
5	0.40	16	14227	99.87	17	25.0	1108	7274	51.06	29	1600.0	87	168	1.18
6	0.56	4	14211	99.76	18	35.0	1050	6166	43.29	30	2200.0	46	81	0.57
7	0.79	25	14207	99.73	19	50.0	979	5116	35.91	31	3100.0	24	35	0.25
8	1.1	150	14182	99.56	20	70.0	895	4137	29.04	32	4400.0	9	11	0.08
9	1.6	239	14032	98.50	21	99.0	734	3242	22.76	33	6300.0	0	2	0.01
10	2.2	612	13793	96.83	22	140.0	641	2508	17.61	34	8800.0	2	2	0.01
11	3.2	856	13181	92.53	23	200.0	462	1867	13.11					

VALUE EXCEEDED 'P' PERCENT OF TIME
P95 = 2.6
P90 = 3.7
P75 = 8.1
P70 = 10.5
P50 = 25.4
P25 = 88.7
P10 = 277.0

LOWEST MEAN DISCHARGE AND RANKING FOR THE FOLLOWING NUMBER OF CONSECUTIVE DAYS IN YEAR ENDING MARCH 31

YEAR	1	3	7	14	30	60	90	120	183
1948	3.40 25	4.00 25	4.60 27	5.00 26	6.80 28	12.00 31	15.00 30	15.00 25	35.00 25
1949	1.30 8	1.30 7	1.50 6	1.70 6	1.70 4	2.20 3	3.10 5	12.00 20	19.00 17
1950	2.00 15	2.00 11	2.20 13	2.50 13	3.00 13	3.90 15	5.30 16	4.90 9	12.00 10
1951	3.30 24	3.60 24	4.30 24	4.80 24	5.80 26	11.00 28	33.00 34	36.00 34	71.00 34
1952	1.70 12	1.70 9	1.80 8	2.20 9	2.70 10	2.80 5	2.90 3	4.30 7	11.00 7
1953	1.19 6	1.19 5	1.19 4	1.30 4	1.90 5	2.90 6	6.60 17	12.00 21	11.00 8
1954	0.60 2	0.80 2	1.19 5	1.19 2	1.40 2	1.70 1	1.90 1	2.30 1	4.60 5
1955	0.30 1	0.30 1	0.33 1	0.53 1	0.91 1	3.30 10	3.80 10	6.30 12	27.00 23
1956	1.40 9	2.10 12	2.10 10	2.20 10	3.00 14	5.60 19	34.00 35	38.00 35	49.00 32
1957	2.90 20	3.10 20	3.40 22	3.90 22	4.00 19	4.50 17	5.10 15	7.80 15	14.00 14
1958	3.70 26	4.30 26	4.60 25	5.10 27	7.40 30	12.00 32	14.00 28	20.00 29	86.00 36
1959	7.30 35	7.80 36	8.80 36	9.90 36	10.00 36	13.00 33	18.00 31	34.00 33	67.00 33
1960	1.50 10	1.60 8	1.70 7	1.80 7	1.90 6	3.20 9	4.50 14	6.30 13	12.00 11
1961	1.90 13	2.10 13	2.20 11	2.20 8	2.30 7	2.90 7	3.40 6	3.80 4	4.20 4
1962	11.00 37	12.00 37	12.00 37	13.00 37	14.00 37	32.00 36	40.00 36	50.00 36	79.00 35
1963	5.00 32	5.00 31	5.10 30	6.00 30	8.10 31	11.00 29	11.00 25	12.00 22	13.00 12
1964	1.00 3	1.00 3	1.00 2	1.40 5	2.40 8	3.10 8	3.40 7	3.20 3	4.00 1
1965	2.00 14	2.10 14	2.20 12	2.30 11	2.60 9	2.70 4	2.90 4	3.00 2	4.10 3
1966	1.10 4	1.30 6	1.90 9	2.50 12	2.90 11	3.80 13	4.30 11	5.80 11	13.00 13
1967	1.19 7	1.90 10	2.50 14	2.90 14	4.10 20	6.50 22	8.90 21	11.00 19	26.00 22
1968	1.70 11	2.10 15	2.60 15	2.90 15	3.20 16	3.80 14	4.30 12	5.50 10	11.00 9
1969	3.20 23	3.50 23	3.80 23	3.90 23	4.40 22	5.60 20	9.50 22	14.00 23	39.00 27
1970	4.30 28	4.50 28	5.00 29	6.20 31	7.10 29	17.00 34	23.00 32	27.00 31	40.00 28
1971	2.90 21	3.10 21	3.20 20	3.40 19	3.60 18	4.00 16	4.30 13	4.70 8	9.70 6
1972	4.40 29	4.50 29	4.60 26	5.00 25	5.30 24	7.80 25	15.00 29	16.00 26	19.00 18
1973	7.40 36	7.50 35	7.60 35	8.10 35	8.90 33	36.00 37	57.00 37	72.00 37	124.00 37
1974	7.00 34	7.00 34	7.10 34	7.70 34	8.50 32	8.80 26	9.80 23	26.00 30	45.00 30
1975	3.80 27	4.30 27	4.70 28	5.30 28	5.80 25	7.70 24	11.00 26	15.00 24	20.00 19
1976	6.10 33	6.30 33	6.50 33	7.00 32	9.00 34	22.00 35	25.00 33	29.00 32	46.00 31
1977	2.10 16	2.30 16	2.80 19	2.90 16	3.10 15	3.40 11	3.60 8	3.90 5	4.00 2
1978	2.10 17	2.50 17	2.70 16	3.00 18	3.50 17	5.90 21	6.90 18	7.50 14	18.00 15
1979	3.10 22	3.20 22	3.30 21	3.50 20	4.20 21	5.20 18	7.50 19	10.00 18	18.00 16
1980	13.00 38	14.00 38	14.00 38	17.00 38	24.00 38	44.00 38	87.00 38	154.00 38	136.00 38
1981	4.50 30	4.80 30	5.50 31	6.00 29	6.50 27	9.40 27	10.00 24	9.70 17	24.00 20
1982	5.00 31	5.50 32	6.40 32	7.60 33	9.40 35	12.00 30	12.00 27	17.00 27	37.00 26
1983	2.40 19	2.50 18	2.70 17	2.90 17	3.00 12	3.40 12	3.70 9	4.30 6	26.00 21
1984	1.10 5	1.10 4	1.19 3	1.30 3	1.50 3	1.80 2	2.40 2	8.90 16	31.00 24
1985	2.30 18	2.70 19	2.80 18	3.90 21	5.20 23	6.80 23	8.60 20	19.00 28	42.00 29

APPENDIX D-2 (CONTINUED)

HIGHEST MEAN DISCHARGE AND RANKING FOR THE FOLLOWING NUMBER OF CONSECUTIVE DAYS IN YEAR ENDING SEPTEMBER 30

YEAR	1	3	7	15	30	60	90	120	183
1947	2030.00 30	1470.00 26	966.00 24	680.00 22	489.00 22	452.00 12	364.00 14	284.00 19	233.00 17
1948	2740.00 21	2100.00 15	1846.00 6	1170.00 6	1020.00 2	687.00 3	510.00 3	427.00 3	292.00 9
1949	4440.00 7	2750.00 10	1750.00 15	992.00 9	746.00 9	537.00 9	450.00 5	405.00 5	312.00 5
1950	4440.00 8	3200.00 4	1750.00 8	1310.00 3	895.00 4	706.00 2	557.00 2	471.00 2	352.00 2
1951	3410.00 14	2080.00 16	1000.00 17	752.00 18	475.00 23	395.00 18	346.00 15	340.00 10	297.00 8
1952	2600.00 22	1720.00 22	1000.00 29	707.00 21	528.00 20	413.00 16	371.00 13	326.00 12	266.00 13
1953	2570.00 23	1330.00 29	887.00 26	610.00 25	353.00 33	230.00 35	233.00 31	205.00 30	178.00 28
1954	777.00 39	607.00 37	336.00 38	213.00 37	177.00 38	117.00 38	91.00 38	77.00 39	56.00 38
1955	2090.00 28	1260.00 31	741.00 33	561.00 28	316.00 35	250.00 32	254.00 27	218.00 28	168.00 30
1956	3050.00 18	2040.00 17	1010.00 22	537.00 32	359.00 31	291.00 29	227.00 32	200.00 31	192.00 25
1957	5180.00 5	3110.00 7	1640.00 9	1070.00 7	666.00 10	497.00 11	469.00 4	417.00 4	336.00 4
1958	11300.00 1	8080.00 1	4920.00 1	2630.00 1	1430.00 1	791.00 1	583.00 1	474.00 1	353.00 1
1959	5960.00 3	4110.00 3	1970.00 3	1070.00 8	863.00 5	549.00 7	414.00 9	374.00 7	272.00 12
1960	1610.00 34	988.00 36	708.00 35	405.00 36	351.00 34	214.00 36	173.00 35	158.00 35	115.00 35
1961	1950.00 32	1150.00 32	870.00 28	747.00 19	627.00 12	507.00 10	388.00 11	308.00 15	241.00 16
1962	3980.00 10	2000.00 18	975.00 23	590.00 26	424.00 26	354.00 22	310.00 21	249.00 23	187.00 26
1963	4500.00 6	2230.00 13	1230.00 16	863.00 16	593.00 14	342.00 24	240.00 30	186.00 33	127.00 34
1964	6040.00 2	4370.00 2	2220.00 2	1210.00 5	815.00 8	603.00 4	415.00 8	324.00 14	215.00 19
1965	2480.00 26	1280.00 30	823.00 30	491.00 33	394.00 28	329.00 26	287.00 24	227.00 25	156.00 32
1966	805.00 37	537.00 38	337.00 37	195.00 39	180.00 37	104.00 39	90.00 39	94.00 37	78.00 37
1967	3160.00 16	2580.00 12	1780.00 7	969.00 11	557.00 18	330.00 25	275.00 25	286.00 17	251.00 15
1968	2060.00 29	1380.00 28	1030.00 20	624.00 24	401.00 27	296.00 28	246.00 29	220.00 26	202.00 23
1969	2100.00 27	1550.00 24	882.00 27	558.00 30	377.00 29	265.00 30	217.00 33	197.00 32	176.00 29
1970	2550.00 24	1470.00 27	810.00 31	471.00 34	306.00 36	239.00 33	249.00 28	205.00 29	159.00 31
1971	1340.00 36	1010.00 35	891.00 25	540.00 31	369.00 30	235.00 34	168.00 36	151.00 36	111.00 36
1972	2490.00 25	1810.00 20	1010.00 21	677.00 23	492.00 21	327.00 27	258.00 26	220.00 27	198.00 24
1973	2980.00 19	1780.00 21	1170.00 18	987.00 10	589.00 15	440.00 14	345.00 16	286.00 18	311.00 6
1974	2850.00 20	2100.00 14	1400.00 13	916.00 12	555.00 19	412.00 17	332.00 17	307.00 16	221.00 18
1975	3590.00 12	2820.00 9	1410.00 12	879.00 15	616.00 13	443.00 13	387.00 12	349.00 8	264.00 14
1976	3150.00 17	2000.00 19	1160.00 19	858.00 17	565.00 17	377.00 21	314.00 20	258.00 21	183.00 27
1977	777.00 38	471.00 39	285.00 39	212.00 38	144.00 39	126.00 37	101.00 37	79.00 38	54.00 39
1978	3430.00 13	2650.00 11	1890.00 5	1390.00 2	849.00 7	539.00 8	400.00 10	340.00 11	286.00 10
1979	3740.00 11	2940.00 8	1900.00 4	1250.00 4	902.00 3	602.00 5	440.00 7	348.00 9	351.00 3
1980	5640.00 4	3140.00 6	1440.00 11	747.00 20	665.00 11	392.00 19	315.00 19	325.00 13	272.00 11
1981	3250.00 15	1500.00 25	723.00 34	560.00 29	474.00 24	386.00 20	316.00 18	253.00 22	203.00 22
1982	2000.00 31	1670.00 23	1390.00 14	897.00 14	857.00 6	584.00 6	445.00 6	382.00 6	307.00 7
1983	1840.00 33	1130.00 33	650.00 36	422.00 35	355.00 32	254.00 31	184.00 34	164.00 34	142.00 33
1984	1530.00 35	1020.00 34	784.00 32	571.00 27	426.00 25	352.00 23	295.00 23	248.00 24	214.00 20
1985	4120.00 9	3160.00 5	1640.00 10	915.00 13	575.00 16	416.00 15	296.00 22	274.00 20	211.00 21

ANNUAL VALUES

ANNUAL MEAN DISCHARGE AND RANKING
IN YEAR ENDING SEPTEMBER 31

1948	00 32
1949	00 35
1950	00 30
1951	00 31
1952	100 25
1953	92 10
1954	52 3
1955	99 13
1956	114 17
1957	76 7
1958	194 33
1959	277 38
1960	89 11
1961	67 5
1962	165 29
1963	91 12
1964	47 2
1965	116 19
1966	66 4
1967	129 24
1968	105 15
1969	106 16
1970	100 14

ANNUAL MEAN DISCHARGE AND RANKING
IN YEAR ENDING SEPTEMBER 30

1947	132.00 18
1948	154.00 11
1949	179.00 6
1950	191.00 5
1951	161.00 8
1952	139.00 16
1953	96.00 30
1954	30.00 39
1955	107.00 27
1956	127.00 19
1957	177.00 7
1958	223.00 1
1959	144.00 14
1960	65.00 35
1961	135.00 17
1962	123.00 21
1963	68.00 34
1964	110.00 25
1965	80.00 33
1966	47.00 37
1967	139.00 15
1968	116.00 24
1969	106.00 28

APPENDIX D-2 (CONTINUED)

ANNUAL VALUES--Continued

ANNUAL MEAN DISCHARGE AND RANKING IN YEAR ENDING MARCH 31

1971	77.00	8
1972	69.00	6
1973	237.00	36
1974	153.00	28
1975	141.00	26
1976	126.00	23
1977	27.00	1
1978	125.00	22
1979	117.00	20
1980	240.00	37
1981	115.00	18
1982	204.00	34
1983	78.00	9
1984	125.00	21
1985	145.00	27

ANNUAL MEAN DISCHARGE AND RANKING IN YEAR ENDING SEPTEMBER 30

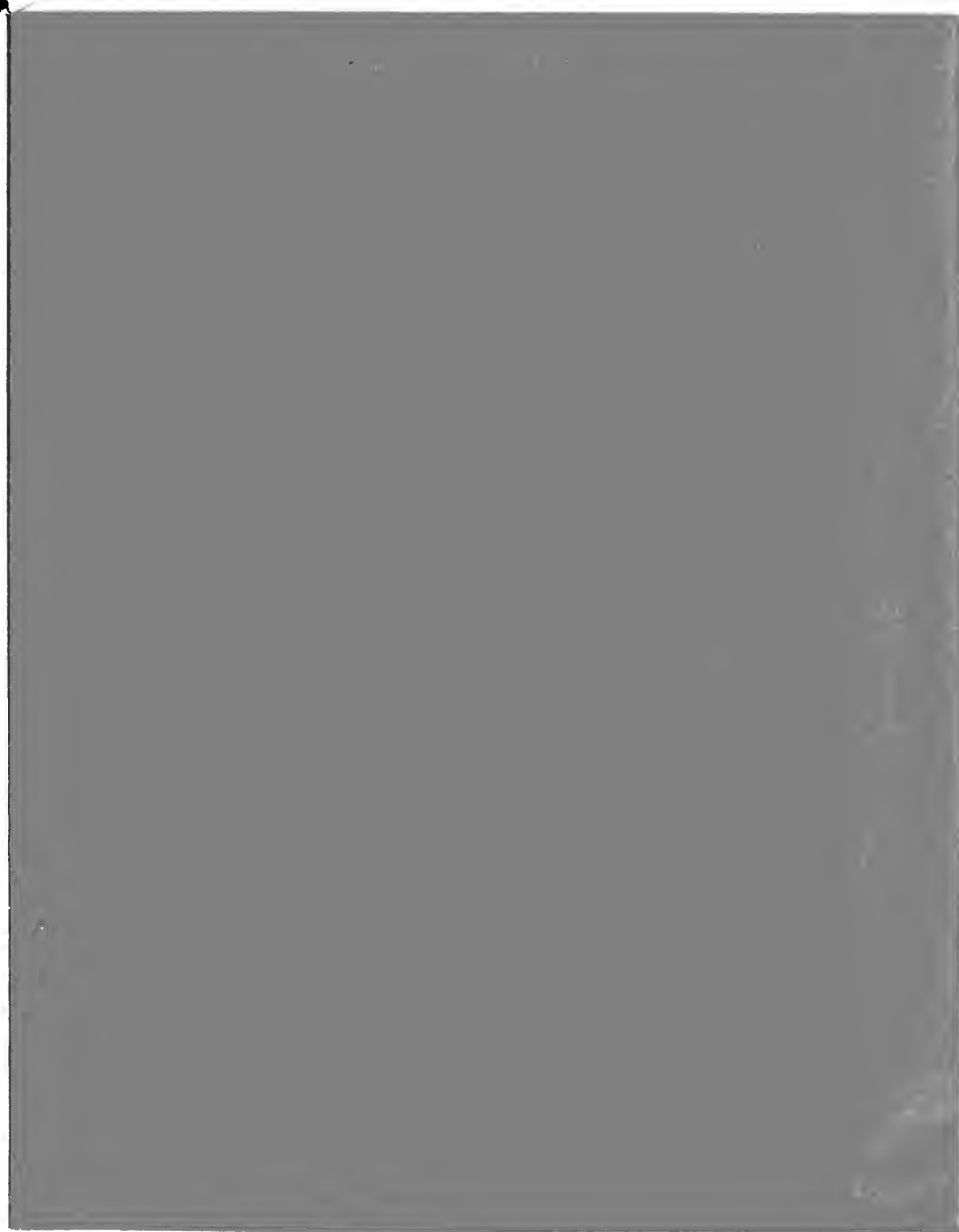
1970	90.00	31
1971	62.00	36
1972	145.00	13
1973	200.00	3
1974	121.00	22
1975	151.00	12
1976	101.00	29
1977	30.00	38
1978	156.00	10
1979	209.00	2
1980	195.00	4
1981	109.00	26
1982	160.00	9
1983	82.00	32
1984	126.00	20
1985	118.00	23

NORMAL MONTHLY MEANS (ALL DAYS)

YEAR	OCT	NOV	DEC	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT
1947	1.25	4.12	22.50	229.00	46.80	111.00	333.00	322.00	355.00	17.40	129.00	9.44
1948	23.60	12.30	31.40	179.00	382.00	509.00	615.00	49.10	20.40	38.70	5.06	1.79
1949	3.01	208.00	324.00	725.00	198.00	331.00	74.10	35.50	189.00	45.50	4.94	3.69
1950	8.81	3.78	18.00	865.00	548.00	252.00	194.00	62.60	156.00	118.00	14.70	69.30
1951	44.80	185.00	317.00	297.00	427.00	308.00	204.00	122.00	32.00	11.60	3.78	2.81
1952	3.12	15.30	300.00	427.00	251.00	300.00	226.00	86.50	9.96	2.37	13.80	26.10
1953	3.93	12.80	86.00	170.00	125.00	290.00	48.10	342.00	21.70	33.10	13.00	2.78
1954	1.70	1.82	3.80	19.70	33.90	96.10	117.00	33.20	36.70	6.72	6.92	0.99
1955	103.00	74.30	114.00	213.00	229.00	264.00	87.50	28.50	48.80	88.60	6.32	35.90
1956	165.00	359.00	43.40	21.60	340.00	160.00	181.00	120.00	84.50	52.10	16.10	4.41
1957	4.79	6.21	39.90	177.00	188.00	46.10	617.00	321.00	461.00	251.00	12.30	16.50
1958	17.80	38.80	376.00	66.30	68.70	81.20	166.00	161.00	1417.0	100.00	167.00	20.90
1959	10.10	64.60	38.50	575.00	422.00	218.00	256.00	132.00	18.60	8.22	4.26	2.82
1960	11.00	32.30	97.50	196.00	217.00	96.70	49.90	34.90	17.80	18.10	7.77	3.29
1961	4.24	5.00	2.93	3.51	142.00	513.00	437.00	78.20	67.60	58.40	177.00	134.00
1962	22.80	46.50	53.10	404.00	203.00	308.00	43.90	72.30	29.20	265.00	13.60	12.00
1963	11.50	17.80	8.19	16.50	21.60	565.00	95.90	39.10	13.20	8.65	6.06	3.11
1964	3.16	4.42	2.62	6.66	5.00	375.00	810.00	45.90	52.30	10.50	4.10	3.00
1965	2.60	3.21	3.35	29.90	192.00	261.00	394.00	56.70	18.00	7.84	3.34	5.68
1966	43.50	7.22	11.10	83.90	112.00	58.50	71.20	132.00	16.50	8.98	4.14	24.10
1967	6.10	145.00	496.00	93.20	131.00	407.00	138.00	189.00	30.00	12.10	5.20	3.38
1968	4.49	11.40	389.00	188.00	148.00	139.00	130.00	202.00	121.00	20.40	30.10	5.08
1969	6.28	84.70	171.00	281.00	144.00	76.70	191.00	175.00	61.80	27.50	36.40	21.80
1970	32.20	104.00	48.50	166.00	163.00	173.00	276.00	53.70	43.60	20.40	10.20	3.67
1971	4.52	5.49	18.00	32.10	343.00	141.00	28.10	96.60	41.70	16.30	5.35	32.10
1972	18.30	10.00	257.00	122.00	32.80	160.00	489.00	118.00	100.00	90.50	10.40	337.00
1973	93.30	589.00	291.00	146.00	111.00	478.00	254.00	72.50	250.00	23.80	82.60	8.67
1974	9.22	57.30	210.00	476.00	194.00	203.00	160.00	41.10	40.60	12.60	21.60	25.70
1975	6.15	16.80	222.00	307.00	533.00	326.00	144.00	54.50	154.00	12.30	50.70	13.30
1976	51.00	29.20	153.00	219.00	476.00	174.00	25.80	16.70	53.20	19.50	5.30	3.50
1977	4.37	4.34	3.63	3.25	75.40	108.00	82.50	47.00	10.10	3.91	8.14	17.40
1978	54.00	14.20	473.00	36.30	18.80	714.00	318.00	138.00	22.80	39.10	21.00	6.30
1979	5.74	11.90	103.00	139.00	170.00	427.00	261.00	58.50	116.00	709.00	454.00	42.30
1980	48.80	385.00	159.00	82.50	108.00	441.00	144.00	35.80	658.00	125.00	153.00	11.90
1981	9.79	10.70	11.20	11.00	150.00	69.10	173.00	352.00	389.00	83.90	27.80	30.80
1982	14.10	11.10	63.60	225.00	473.00	622.00	160.00	190.00	159.00	16.00	4.60	3.47
1983	3.51	37.90	160.00	37.20	90.20	72.30	263.00	209.00	60.40	53.90	2.13	1.78
1984	20.00	132.00	236.00	22.50	187.00	318.00	370.00	109.00	36.50	73.60	7.49	6.74
1985	25.20	125.00	182.00	95.80	434.00	305.00	140.00	54.70	30.60	18.70	24.60	5.12

APPENDIX D-2 (CONTINUED)

OCT	NOV	DEC	JAN	FEB	MARCH
TWENTY FIFTH PERCENTILE					
4.37	7.22	18.00	32.10	108.00	111.00
FIFTIETH PERCENTILE					
9.79	16.80	97.50	146.00	170.00	261.00
SEVENTY FIFTH PERCENTILE					
25.19	84.70	236.00	229.00	340.00	375.00
APRIL	MAY	JUNE	JULY	AUG	SEPT
TWENTY FIFTH PERCENTILE					
95.90	47.00	22.80	12.10	5.20	3.38
FIFTIETH PERCENTILE					
173.00	78.20	48.80	20.40	10.40	6.74
SEVENTY FIFTH PERCENTILE					
276.00	161.00	154.00	73.60	27.80	24.10



LEGEND

PARENT MATERIALS (GROUPED ACCORDING TO LAND FORM AND ORIGIN)

- RIDGE MORaine
- GROUND MORaine WISCONSINAN
- LACUSTRINE PLAIN
- FLOOD PLAIN
- MUCK BASINS
- OUTWASH PLAIN
- TERRACES

TEXTURAL SYMBOLS (SUPERIMPOSED ON PARENT MATERIAL TO SHOW RELATIVE COMPOSITION)

- GRAVEL
- SAND
- SILT
- CLAY

MISCELLANEOUS

- GRAVEL PIT
- LAKE AND POND
- HIGHLY ORGANIC TOPSOIL
- URBAN AREA
- MARSH OR SWAMP
- BORING SITE

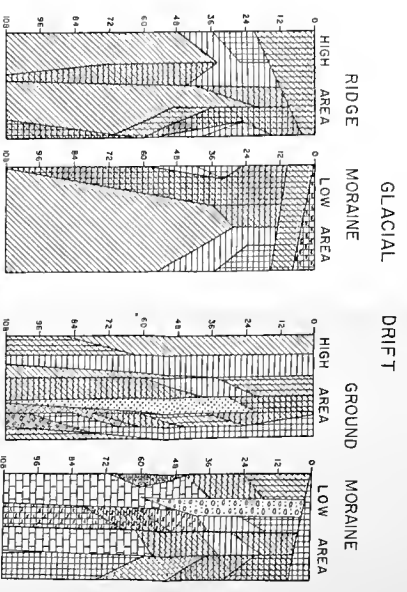


ENGINEERING SOILS MAP RANDOLPH COUNTY INDIANA

PREPARED FROM
1941 AAA AERIAL PHOTOGRAPHS
BY
JOINT HIGHWAY RESEARCH PROJECT
AT
PURDUE UNIVERSITY
1992

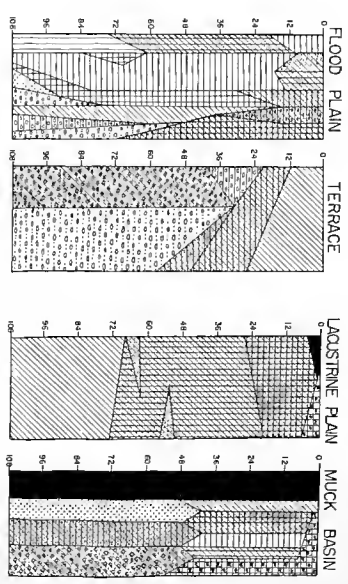


GENERAL SOIL PROFILES



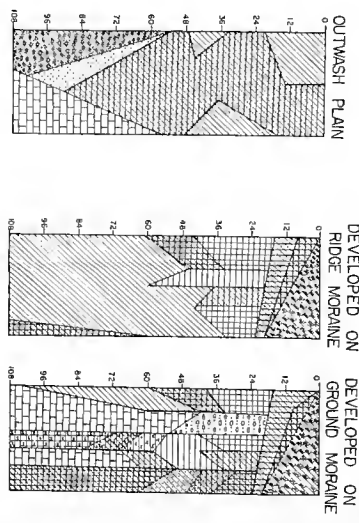
FLUVIAL DRIFT

LACUSTRINE DRIFT



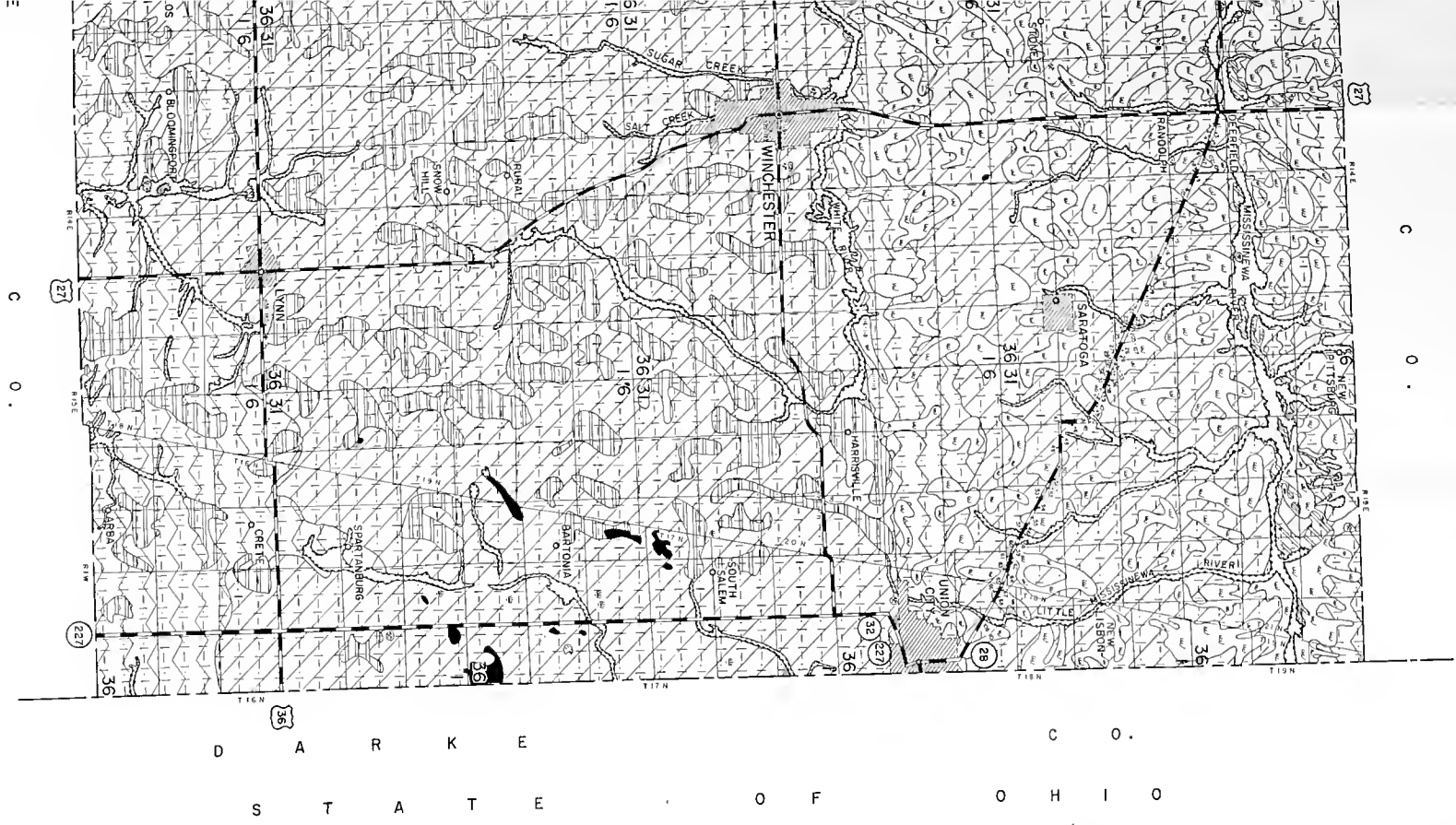
GLACIAL-FLUVIAL DRIFT

HIGHLY ORGANIC TOPSOIL



TEXTURAL SYMBOLS FOR SOIL PROFILES

- GRAVEL
- SAND
- SILT
- CLAY
- LOAM
- MUCK
- MARL
- ORGANIC MATERIAL
- LIMESTONE



SOILS MAP
RANDOLPH COUNTY
INDIANA
PREPARED FROM
AERIAL PHOTOGRAPHS
BY
RESEARCH PROJECT
AT
UNIVERSITY
1992

COVER DESIGN BY ALDO GIORGINI